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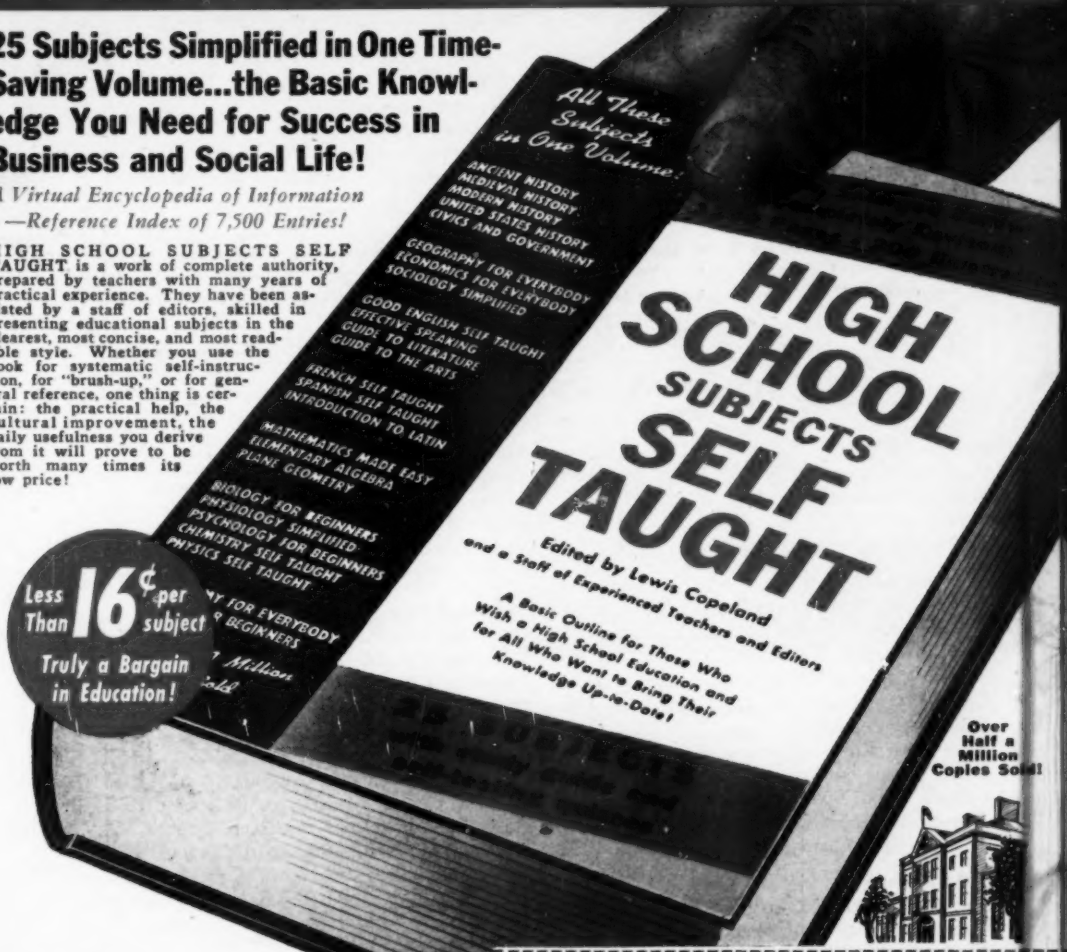

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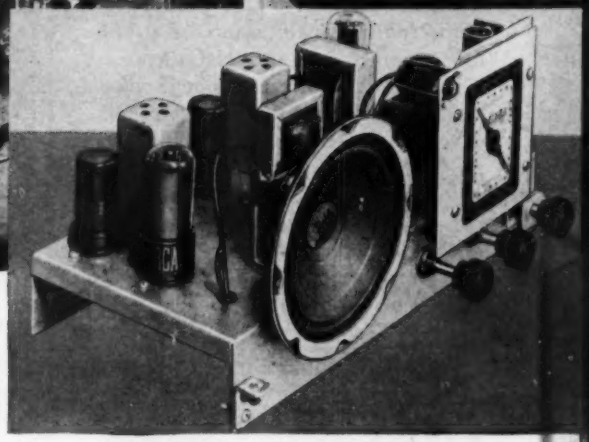

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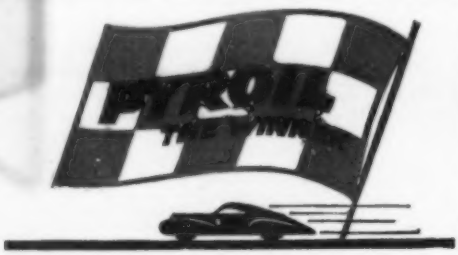

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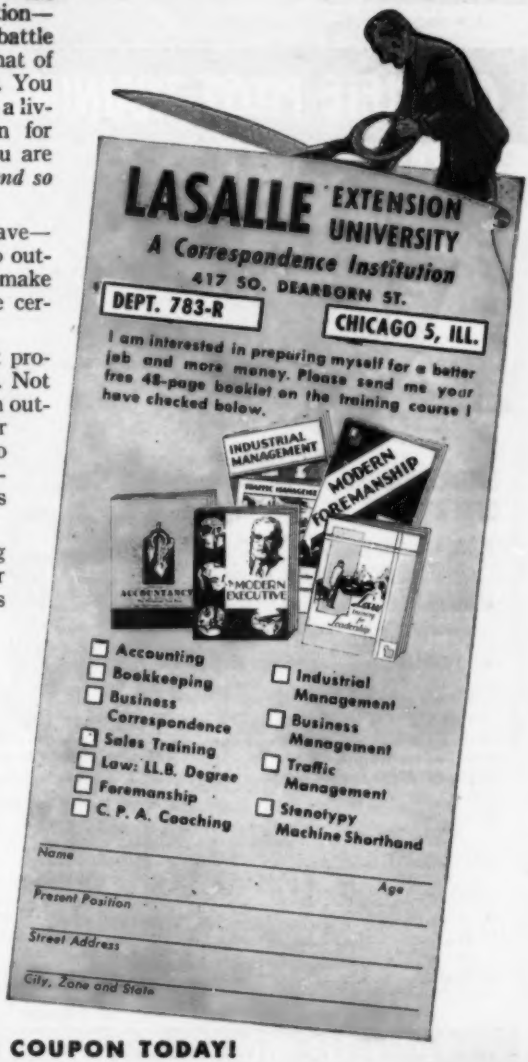

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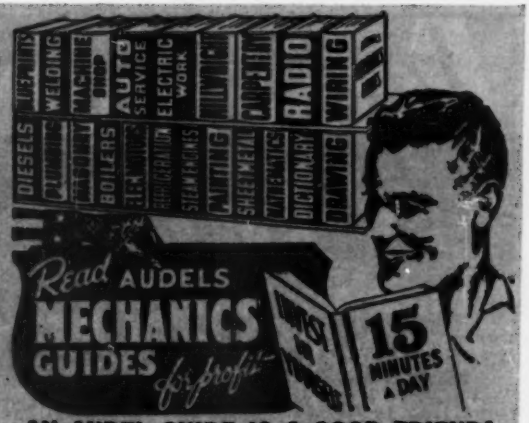

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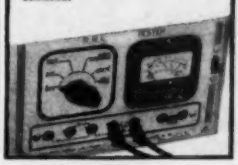

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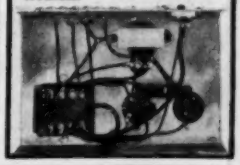

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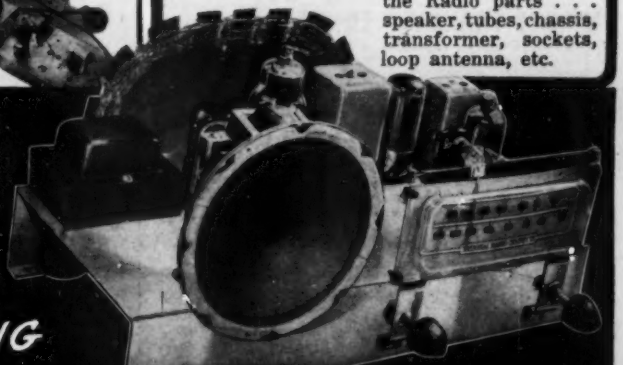

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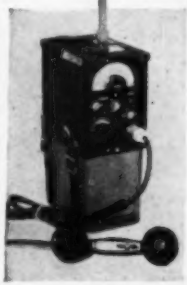

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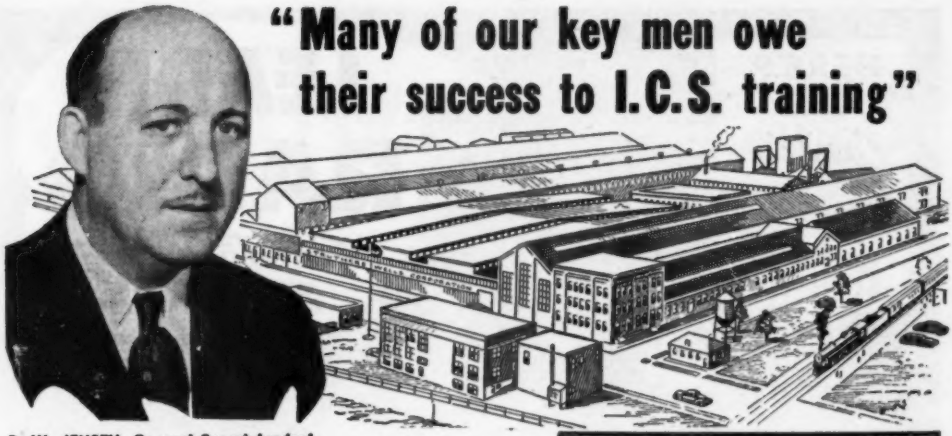

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Letters

Flying Saucers?

Sir:

After reading "Are Secret Balloons Flying Saucers?" in Popular Science of May, 1948, I have decided it was the work of a moron or a liar. . . .

I have seen flying discs five times. I have taken and obtained two photographs of discs. . . . Do balloons travel against the wind at 10,000 to 14,000 feet? Do balloons travel in formation like birds? Do balloons have holes in the center? . . .

I am surprised that a science magazine such as yours would publish such nonsense . . .

CHARLES W. SHANGLE, JR.

Boise, Idaho

Sir:

. . . I saw them, too, and they weren't balloons. Also, I wasn't seeing spots in front of my eyes. Some of the "flying saucers" might accidentally have turned out to be balloons, but not all of them. Officialdumb can sure think up some goofy reasons for things they don't understand. . . .

The ones I saw were flying in perfect formation . . . it was late at night. There was no searchlight that could be seen closer than at Chattanooga. All others were blocked off by the mountains. And yet they gave off an extremely bright glow which nearly lit up the landscape like day. . . .

MRS. FELIX G. MATTHEWS

Columbia, S. C.

Sir:

. . . I think that your story about the balloons is one of the best explanations, but here is mine.

Last summer in Port Huron, Michigan, they had a celebration of their "Blue Water Festival." . . . While still in town we passed a large searchlight. After leaving town we could still see the beam. . . . When reaching camp we could no longer see the beam but saw the patch of light it made on low clouds. To us it seemed a very convincing "flying saucer"—if we hadn't known better. . . .

RONALD KORSAK

Oceanside, Calif.

Sir:

. . . I doubt if the reporter who wrote the

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article observed many of the research balloons in flight. I have. I was formerly with the United States Weather Bureau and watched a good many of them. . . .

There is one outstanding characteristic about them that instantly becomes obvious to an observer who has one pointed out to him in flight. That is its apparent motionless. . . . I have frequently seen them mistaken for stars or fixed bodies. . . .

The one feature which was in common about most eyewitness descriptions of the "flying saucers" was speed. . . . That rules out the weather balloons without question because they just don't look that way. . . . I'm afraid your reporter will have to try again.

PHILIP A. HASTINGS

Smithfield, Utah

PS will accept the flying saucers as scientific fact when a captive saucer is produced. To date, captive "saucers" include a factory gear wheel that let loose and landed in a back yard, and a standard weather balloon.

New Isotope Chart

Sir:

Would you kindly advise me where I can obtain a copy or information of the new isotope chart of the elements which was partly shown in the March 1948 issue of POPULAR SCIENCE ["U. S. Alchemists Make Gold," p. 161]. I am a chemistry student and would like to obtain one for my class.

JACK STORY

Parkertown, N. J.

The complete chart has been made available by the Addison-Wesley Press, Inc., Kendall Square Building, Cambridge 42, Mass., at 50 cents for a folded reference copy and $1.25 for a larger, wall-size copy.

Rocket Brakes for Rockets

Sir:

In regard to your article "Rocket Locomotive Hits 1,000 M.P.H.," page 120, March, 1948, why not stop 'em like they start 'em?

Three or four rockets headed the other way and set off just before the vehicle reaches the end of the run should do it.

J. W. SHARPE

Columbus, Ohio

A good idea, but unfortunately it doesn't work. Since the 1,000-m.p.h. rocket makes

P A T E N T S

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The inventor should date and sign his disclosure and have it witnessed by two or more persons who are capable of understanding his invention. The disclosure should then be mailed to the registered patent attorney or agent whom he selects to assist him. The disclosure should be accompanied by a letter authorizing the patent attorney or agent to conduct a preliminary search among previously granted U. S. patents for similar types of invention. The patent attorney or agent then prepares a report of the probable patentability of the invention and recommends the further course the inventor should take, provided the report indicates possible patentability.

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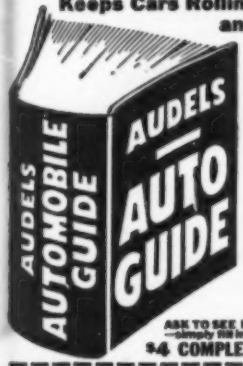

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the entire 2,000-foot run in two seconds, there simply isn't time to get counter rockets into operation. On slow-speed runs of about 500 m.p.h., however, a counter rocket was actually used. On a proposed 10,000-foot track, it may be possible to employ counter rockets at the higher speeds. If rockets are not feasible, water brakes may be used.

Superhet Headache

Sir:

In April and May issues, please note a slight mistake in schematic diagram of "A Superhet the Beginner Can Build." A connection drawn from the second IF transformer [AVC terminal] to the first audio tube [pin 2 of the 12SQ7]. . . .

JOHN J. BALK

Phila., Pa.

Sir:

. . . I built the set as directed and the tubes light and the check voltages are as listed, but the only station I can receive is a local on 1450 kc.

J. R. RAWLS

Suffolk, Va.

Mr. Balk is right, which probably accounts for the trouble Mr. Rawls and other readers have noticed. The connection from the AVC terminal of IF2 to R6 and C6 is wrong and should be removed from the circuit. It will produce a marked loss in volume, possible oscillation, and instability. The pictorial diagram at the bottom of page 225, April, is correct in this respect.

Giving Credit Where Due

Sir:

In reading your article in the May issue of PS ["Leapfrog Barge Swims, Walks, Climbs," p. 146] about the "Navy's newest amphibious vehicle," well it just isn't anything new.

I was a member of the Sea Bee outfit known as A.B.C.D. on the island of Oahu T. H., and we, too, made a leapfrog barge. We didn't get the drawings etc. to build it until too late to help in the war. . . .

I must admit the barge in PS is just a little fancier in design, but you have to consider that the gear raceways were bent by hand in our blacksmith shop under Chief Walter Plaskett, and the gears themselves were cast in a foundry we also built.

Plenty of nights a crew worked voluntarily under a Hawaiian moon and welding arcs to

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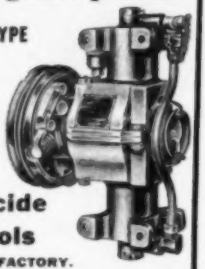

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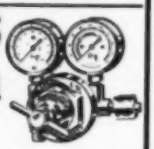

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finish the "monster" in time to be of use to the war effort.

I think Lt. Sterling Thompson and all the rest of the officers and men who worked on it should have at least got a mention in small print.

Was our barge ever recognized? Did it play any part in inspiring the one in PS? I guess we'll never know!

CHARLES HARDING, JR.

Saugus, Mass.

Mr. Harding and his mates were not working in vain. They were performing valuable spadework on the original "walking barge." For security reasons, however, their efforts had to go unsung until now.

Slip of the Typewriter

Sir:

. . . On page 125 [PS, April '48] you pictured the 1948 Cadillac and stated that the model shown was of the Series 50. This seems to be incorrect for no Series 50 is being produced this year. The model pictured is the Fleetwood 60 Special.

FRANK T. NESBITT, JR.

Toledo, Ohio

PS was 10 too low. The model is a Series 60, as Mr. Nesbitt points out.

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Sir:

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How to Take a Pig from a Poke

Sir:

In regard to J. C. Sightler's article, "I tackled a dent" [March, p. 202].

After he inserted the football in the door and re-shaped the door, how did he deflate it to withdraw it?

R. F. CANTONI

Springfield, Ill.

He used an older type of football having a valveless stem on the bladder, so that disconnecting the pump released the air. Otherwise, this would indeed be a problem.

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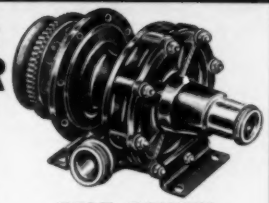

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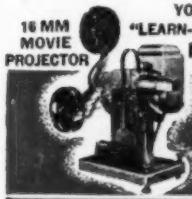

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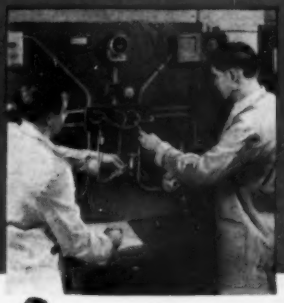

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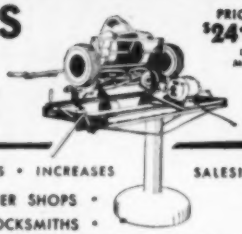

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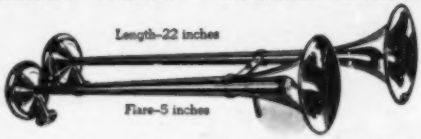

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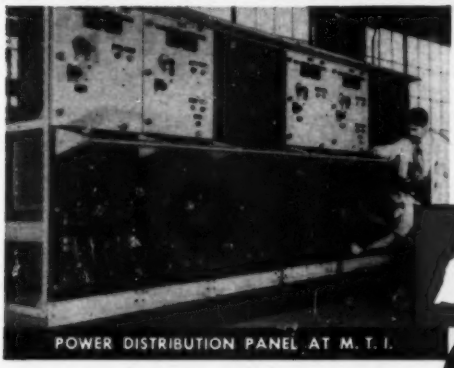

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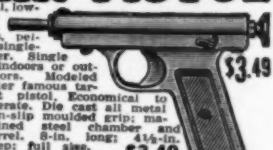

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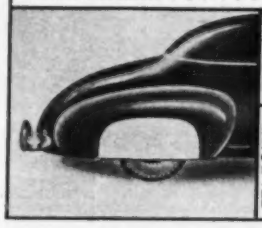

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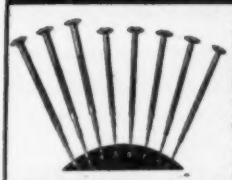

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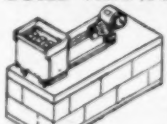

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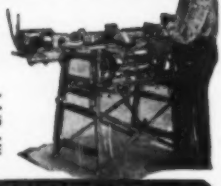

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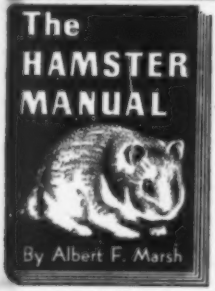

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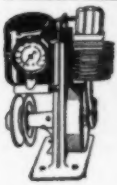

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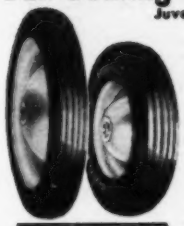

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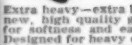

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WHEELS, Tires, Tubes for Motor Scooters, Midget Cars, Wheelbarrows, and Industrial equipment. All sizes. Bicycle Parts, accessories. Largest stock in United States. Send dime for list. Cycle Transport Company, 1241 S. Michigan Ave., Dept. C, Chicago 5, Illinois.

KING Midget $40.00 Briggs Stratton Motor $15.00 3¼ h.p., outboard motor $40.00. Fairbanks Morse 6 h.p. motor $40.00. Parts for Hot Rod, Midgets and big race cars, send 25c in coin for our Exchange Bulletin. Dept. C, Behnke's, 5721 Leland, Chicago 30, Ill.

PISTON RINGS for all engines any size or age, trade discounts. Thomas, Dept. T-22, 1916 W. Valley Blvd., Alhambra, Calif.

WHIZZER & Cushman ground cams & High compression heads, more Speed & Power. Also Telescoping spring forks for motorbikes. Thomas, Dept. T-12, 1916 W. Valley Blvd., Alhambra, Calif.

MOTOR Scooters, bicycle engines. 120 miles gallon. Dime for catalog. Clymer, Desk B-75, 1268 So. Alvarado, Los Angeles 6, Calif.

TELESCOPING bicycle spring fork. The new Thomas Spring Fork is the only telescoping fork made for motorbike and bicycle. Absorbs all road shocks, makes riding velvety smooth $9.95. Write for free illustrated folder. Jobber and dealer openings. Mercury Specialties Co., 1916 W. Valley Blvd., Alhambra, Calif.

MOTORSCOOTER $7.50, midget racer $10, motorbike $5 less motors; Harley single $40. Midget car $55 complete. Motors $4 up. Plenty brand new engines and surplus motorscooters. Over 5000 small tires 1 up. Mail order only. Send 25c for Big War-Bargain catalogue listing the above and hundreds of other bargains in motorscooters, motorcycles, midget racers, outboards, engines, etc. (35c by First Class Mail). Midget Motors Directory, Athens, Ohio.

FLAT rate repair manual for Harley-Davidsons. Gives flat rate charge for every operation. Every dealer, owner, mechanic needs this new book. $2.00 postpaid. Clymer, Dept. B-FR, 1268 So. Alvarado, Los Angeles 6, Calif.

HARLEY-Davidson "45" engines. Gov't Surplus, rebuild with Generator and Carburetor. Few left, close out $89.00. Clymer, Dept. B-7Z, 1268 So. Alvarado, Los Angeles 6, Calif.

EASILY build Professional Midget Racer, Motorscooter, Midget Roadster, or Midget Motorcycle from cast off parts. Plans, specifications for all four contained in illustrated handbook, 25 cents. Directory of bargain priced used parts and motors included free! Mid west, 3839 Drummond, Toledo, Ohio.

MIDGET Car with three-speed transmission — $35. Cushman Motorscooter — $15. Shaw Bicycle Motor—$15. Harley-Davidson Motorcycle—$15. Motorbike outfit—$15. Rush 25 cents for special new catalog listing amazing bargains in motorscooters, used motors, tires, parts, midget cars, etc. Gail, 538 Erie, Toledo, Ohio.

MOTO-Scoot—$35. Midget racer—$15. Indian Motorcycle—$30. Cushman Motorscooter with extra tire—$20. Motors—$3 and up, homemade Motorscooter—$10. Send 25 cents for new catalog listing these and many other sensational bargains in used motors, wheels, tires, motorscooters, midget cars, motorbikes, etc. Associated, Box 1764-CS, Toledo, Ohio.

SENSATIONAL clutch operated Motorscooter $49.75! You assemble from our factory finished kits. Uses any gasoline motor. Complete plans, literature — 25 cents. Zipscoot, Toledo 6, Ohio.

AIRCOOLED engines aplenty cheap list 15c. Motorscooter plans 50c. Donz, Mount Ephraim, N. J.

BICYCLE motors. Save $30. Factory rebuilt. Factory new motor guarantee. Nationally advertised make. Money back guarantee. Write today. A-1 Bike Motors, Box 267, Maywood, Calif.

5 AVIATION

FREE! How to fly cross-country-safely—how to land at airports—told in booklet "Happy Landings," sent to Pilots and Students. Please enclose 10c for postage and handling. Hangar Flying, Dept. (13K7), 112 E. Grove, Bloomington, Ill.

VETERANS: Be a pilot. Tuition paid under the G.I. Bill. Private, Commercial, Flight Instructor, Instrument, and Multi-engine Courses. Opportunities for part-time employment while studying. Ideal flying conditions. Write for information. Gottschalk School of Aeronautics, Adrian, Michigan.

FAMOUS "Zweng" manuals with examinations: Mechanics rating $3.00; Flight engineer $4.00; Navigation $3.00; Link Instructor rating $4.00. (Free catalog). Pan American Navigation Service, 12021-D3, N. Hollywood, Calif.

AEROPLANE tires, tubes, wheels, rims for all Farm machinery. Free list. Marvin A. Northrop Aeroplane Co., 500 Washington North, Minneapolis 1, Minn.

AVIATOR'S Type Sun Glasses, gold plate, green ground lenses, guaranteed, $2.95, 10c postage. Flying goggles, not cheap plastic but glass lenses, metal framed, $4.95. Aviator's type wrist-watch, sweep hand, $7.95. Oxygen bottle, with regulator, hose, mouthpiece, filled with oxygen, $5.95, (small size). 26" miniature airplane propeller, $1.65. Summer helmet, $1.00. Aero Parts Supply, Municipal Airport, Houston, Texas.

PROPELLERS — 2—3 blade, snow-ice sleds, boats. Catalog. Standard Aerocraft, Box 387, Ft. Worth, Texas.

7 ELECTRICAL SUPPLIES & EQUIPMENT

FLUORESCENT lights. Make your own . . . ideal for home and shop. Complete electrical parts for 20-watt fixtures with detailed instructions. Also larger sizes Postpaid only $2.00. Write Fluorokit, 332 E. Reservoir, Milwaukee, Wisconsin.

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LAMPS. Build own originals, parts wholesale any amounts. Catalogue 10c. Brown Lamp Co., No. 501, Wellston, St. Louis 12, Mo.

ELECTRICIANS. Save money on one hole pipe straps. Price per 100. ½"—$1.82, ¾"—$2.35. ½" EMT—$1.68. Sturdy design, strong cast aluminum. Peasley Products, Inc., 151 Connecticut Ave., Bridgeport 7, Conn.

ELECTRIC Pencil: Engraves all metals. $1.00 postpaid. Beyer Mfg., 229-O Dixon, Uniontown, Penna.

ELECTRIC Motor shop tools: Carbide tipped inside commutator boring, sanding, $4.75, $3.75. Featherweight winding guns, $6.00, heads, $49.50. Stator vises, $22.75. Combination insulation folder and tin brake, $32.50. Others. R. Doyle, P. O. Box 224, Vista, Calif.

LAMP parts wholesale. Large variety available, for building, repairing, or remodeling. Order in any quantity. New 1948 catalog, 10c. Gearon Company, 27H South Desplaines, Chicago.

LAMPS—All parts to build or repair. Illustrated catalog 10c. Gyro Lamps, 5402-B Clark, Chicago 40.

RECTIFIERS: Ramyr Selenium Platers, 10, 30, 50, 100 amp sizes. Immediate shipment. Complete line of bronze baby shoe mounts. Write for list. Hollywood Bronze Supply, Dept. S, 1770 N. Vermont, Hollywood 27, Calif.

8 WELDING, SOLDERING

POWER-Welder new combination AC Welder-AC Power Plant. Portable, makes you independent of power lines. Gives you Welding, plus Power for tools, lights, motors . . . anywhere. Free catalog. Write Hobart Welders, Box P-784, Troy, Ohio.

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WELDERS for all requirements. Free catalog. Write Hobartweld, Box P-785, Troy, Ohio.

TRANSFORMER Welders 110 V. Welds ½" Steel $29. Morris Welding Service, 1850B State, Schenectady 4, N. Y.

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10 MACHINERY, TOOLS, SUPPLIES

DRILL GRINDER—Grinds drills to factory accuracy. Calipers with direct reading scales. Circle cutters. New Tool grinder. Lowest prices. Free literature. Factory, 811-A East 31st, Kansas City 3, Mo.

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SEWING Machine handicraft — Your sewing machine equipped with Bright Bit will cut wood, leather, etc. Simple—smooth cut—no drilling—no dust—Simple chisel needle replaces ordinary needle to produce precision cutting. See May issue, American Legion Magazine. Proof 25c. Sewing Handicraft $1.00; 3 chisels $1.00. Bright Bit, East McKeesport, Pa.

WAR Surplus in small tools for machine shop—Send 15c for bulletin. Travers Tool Co., Dept. S, 5 Court Square, Long Island City 1, New York.

OXYGEN MASKS. 40c postpaid. (Coins or stamps) Gov. Surplus 14A10. Convertible dust-paint respirators. Daugherty, 123 So. Pecos, San Antonio, Texas.

POWER master gear reduction unit converts Bandsaws to heavy metal sawing. Conveyers. Farms. Production. Hobby Shops. Ratio 7½-1. Use with ¼ to ½ motor—14 lbs. $9.95. Butt-welded Metal cutting saws 14c ft. Free circular. Power Master Sales, 354 Beale St., Quincy 70, Mass.

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BACK geared metal and wood cutting 12" band saw, 6" jointer, ball bearing, 47" long. Ball bearing spindle shaper, 15x20" table. 8" bench saw, tilting table, ball bearing. Lowest priced line of high grade tools on market. Free catalog. Backus Machine Co., Boyd, Wisconsin.

HOME Lathe owners—Build your own attachments. Send for picture, sample of work and list of blueprints. Cut gears, ratchets, etc. Make neat screws easy way. The Home Shop, 415A Raymond Ave., Glendale 1, Calif.

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CHUCKS. (Genuine Westcott) Independent. Universal, threaded 1½"—8 for South Bend, Atlas, Logan, Clausing, Craftsman lathes. Also other chucks to 16". Top value. Free literature. Westcott Chuck Co., 3700 Walnut, Oneida, N. Y.

16" AND 26" size jigsaws. Ten Dollars & Fourteen Dollars, mail money order. Shellington Machinery, 2055 W. Hunting Park Ave., Phila. 40, Penna.

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BAND Saw—Special $14.95. Ideal for hobbyists & Home Workshop. Circular Free. Woodcraft Tools Inc., 147 E. Lake, Minneapolis, Minn.

DRILL GRINDER for twist drills $2.95. See ad on page 244.

12 FARM MACHINERY

NEW airplane tires, tubes, wheels, bearings, spindles. For harvesters, implements, lowbeds. Free pictures. World's largest stock. Airplane Tire Company, Dept. 20, Box 89, Merced, California.

14 BOATS, OUTBOARD MOTORS, ETC.

FULL size, cut to shape boat patterns, blueprints, 7½—36 feet, illustrated, "Build a Boat" catalog, 10c (coin). "How to Build Boats" book, $1.00. PolyWog Houseboat Plans $10. Cleveland Boat Blueprint Co., Dept. A-77, Cleveland, Ohio.

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OUTBOARD adapter for surplus life rafts. Plans & Complete information $1.00. Jungle Jim, Rt. #4, Box 70, Corpus Christi, Texas.

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P38 DROP Tanks, steel, new, 10 ft. or 6 ft., $9.95. Free picture. Anzio Boat Co., 89v, Merced 3, California.

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BOAT plans, kits. See display advertisement page 247. Marine Mart, Buffalo 7-A, New York.

15 ENGINES, MOTORS, ETC.

WINDING Data, listing 225 motors, single and three phase, $1.00. Motor Data, Box 7631, Kansas City 3, Mo.

ELECTRICAL repair men, send for literature on Motor Winding tester and A.C. motor winder. Motor Industries, Quincy, Illinois.

RANGER Engine—Aircraft—All new in original case. 570 HP, 12 cyl. V type. Aircooled. Engine Spec. No. 177. Complete with spark plugs. Original Government cost over $12,000.00 each. Special offer $200. Crated weight 1200 lbs. No C.O.D. Write for complete description. "Amazing Bachman's," Dept. PS, 23 Herman Street, Rochester 5, N. Y.

GAS drive arc welders. "Build-Your-Own." Portable. Get profitable jobs anywhere. Save $350 with Hobart Generator plus auto engine. Free instruction book. Write Hobart Welders, Box P-787, Troy, Ohio.

WATER-motors all sizes for any purpose. Rotary and Semi-rotary. Duplex Motors, Burlington, Iowa.

18 BODY-BUILDING COURSES

BARBELLS! 95 pound set $9.80; extra plates 9c pound. Send for free course and catalog. Bur Barbell Co., Lyndhurst, N. J.

BAR-BELLS, Dumbbells, Exercise equipment. Courses. Free booklet. Good Barbell Co., Reading, Penna.

19 SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

SINKER molds for making your own sinkers. Several styles, many sizes. Free illustrated folder. Reading Instrument Co., Box 78, Reading, Pa.

"SHOTGUNS"—"Rifles"—"Handarms"—"Ammunition"—"Rods"—"Reels"—List 10c. PS-Rudolph's, Atchison, Kansas.

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180 PAGES antique and modern pistol, sword, etc. values. 50c. Robert Abels, 860½ Lexington Ave., New York 21.

5,000 BARGAINS, firearms, binoculars, war relics, catalog 40c. Smith Museum, Runnemede, N. J.

SPECIAL: 20 assorted spinners for trout, bass, or pan fish. Postpaid $1.00. Dept. 10, Box 313, Lewiston, Idaho.

BULLET-Proof Vests—Weight 5 Lbs. Will stop ammunition from 22 slug to Tommy-gun bullets. Wonderful protection! Sizes 28"-60" $150. Postpaid. Philadelphia Sales Co., 5800 Springfield Ave., Phila. 43, Pa.

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SHOTGUNS, Rifles, Revolvers. Over 500 Modern, Obsolete. Also Cartridges. List .10 coin. Ed Howe, 26 Main Street, Coopers Mills, Maine.

26 FIELD GLASSES, TELESCOPES, ETC.

TELESCOPES, Binoculars, Microscopes, —big bargain catalog free. Brownscope Company, 24 West 45th Street, New York.

CASES, New for 7x50 and 10x50 binoculars all makes. $4.95 postpaid. Max Zweig Sons, 937 D. St. N.W., Washington, D. C.

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31 OPTICAL

CONTACT lens manufacturing information and supplies. Morosco Contacts, 19148 Marx, Detroit 3, Michigan.

34 DOGS, BIRDS, PETS, RABBITS

RAISE rabbits. Market provided, breeding stock furnished on Production Pay Plan. Literature 25c with hutch plans $1. Hansen's Rabbit Institute, 1347 Miller Avenue, Salt Lake City 6, Utah.

RAISE Chinchilla rabbits. Year-round money-makers from furs, meat, breeders. Experience unnecessary. Write today. Willow Farm, Sellerville 16, Pa.

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GOLDEN Hamsters. Profitable, interesting trio $7.00. Probert, Box 315, Valdosta, Ga.

SEE Golden Hamsters ad page 30. Shows picture of hamster.

27 MILK GOATS

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1948 CATALOG, wholesale directory. 10c. Latahaw Sales, Sunnyside-C, Indianapolis 44, Ind.

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61 HELP WANTED

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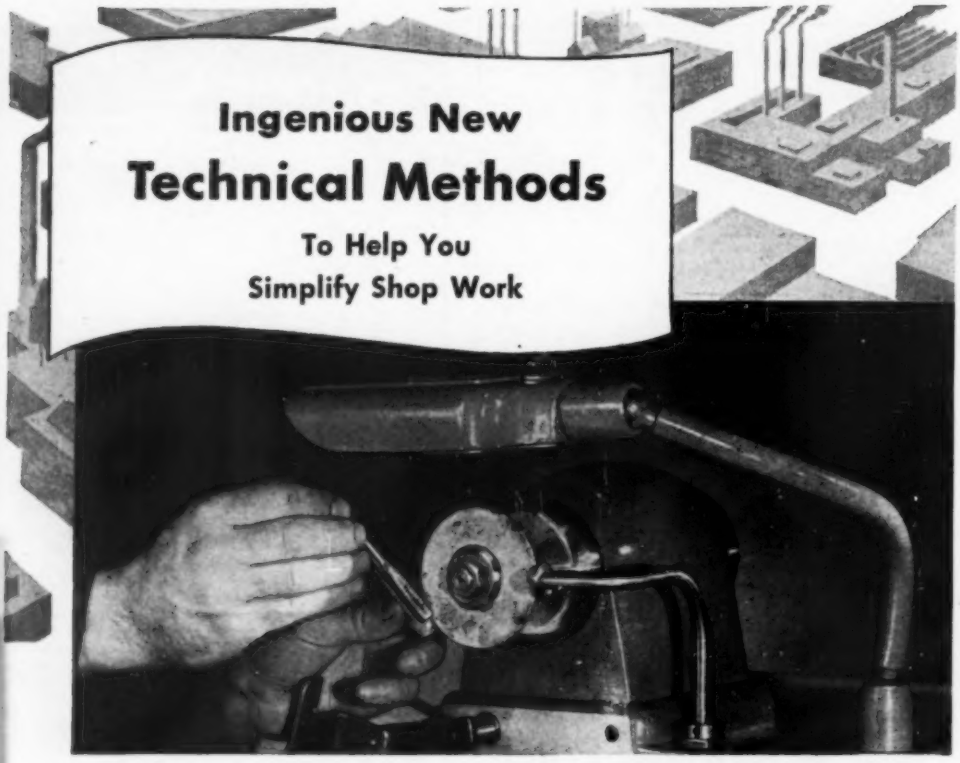

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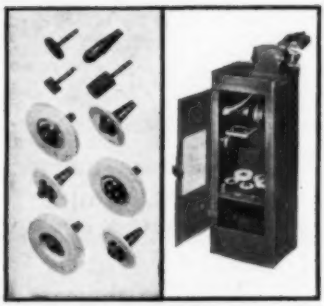

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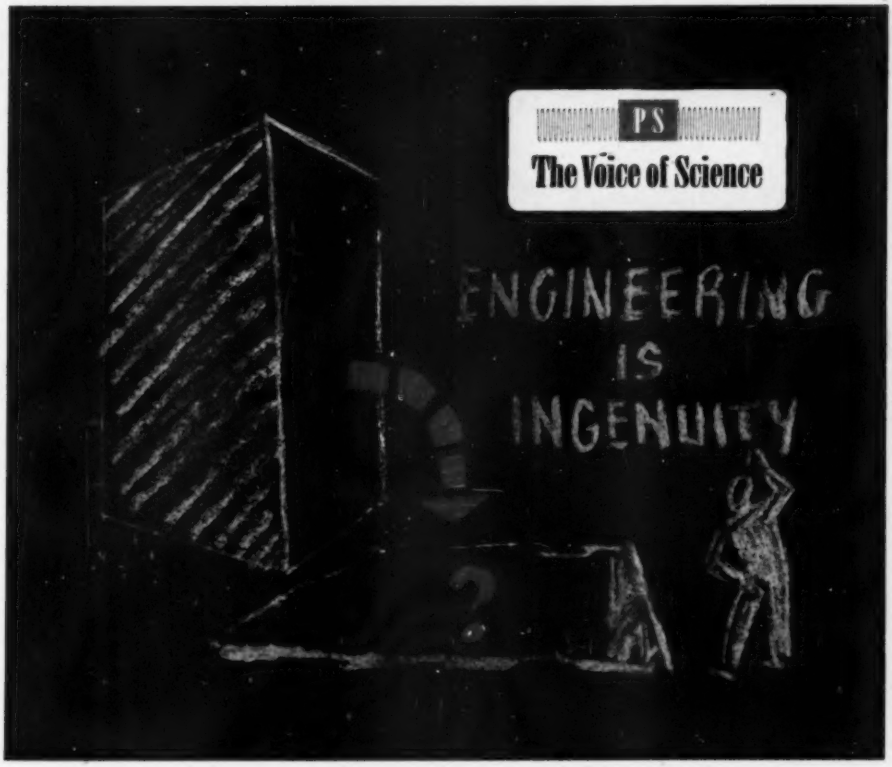

A GREAT engineer told me this story a good many years ago. Colonel Hugh Cooper is dead, but there are many monuments to his memory. One of them was the huge Dnieprostroi Dam in Russia. When I talked to him on his return to this country, he was full of anecdotes about Russian workmen who were then beginning to catch up in mechanical ability with the rest of the world. Some of these workers didn't know a monkey from a wrench. But what they lacked in tool know-how, they made up somewhat in native ingenuity.

The old Colonel's story concerned a party of engineers who had prepared a pit to hold a very heavy piece of equipment. The equipment arrived. Then they were stumped. There wasn't a crane for miles that could handle such a weight, or material available for some substitute lash-up.

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Can you figure out how they did it? It was simple enough.

They simply filled the pit with cakes of ice, skidded the thing into position, sat down to wait for the ice to melt, and pumped out the water as fast as it accumulated.

Colonel Cooper's point was that the engineers ought to have thought of it themselves. They had forgotten that even the words "engineering" and "ingenuity" came from the same Latin source. And that an engineer who gets too far from ingenuity is like a plumber without his tools.

I would like to add that a plumber who has arrived at an ingenious solution of a piping problem is by way of being a good engineer in fact and in spirit.

Perry Gilkeson

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JULY 1948
Popular Science

Under the Hood...

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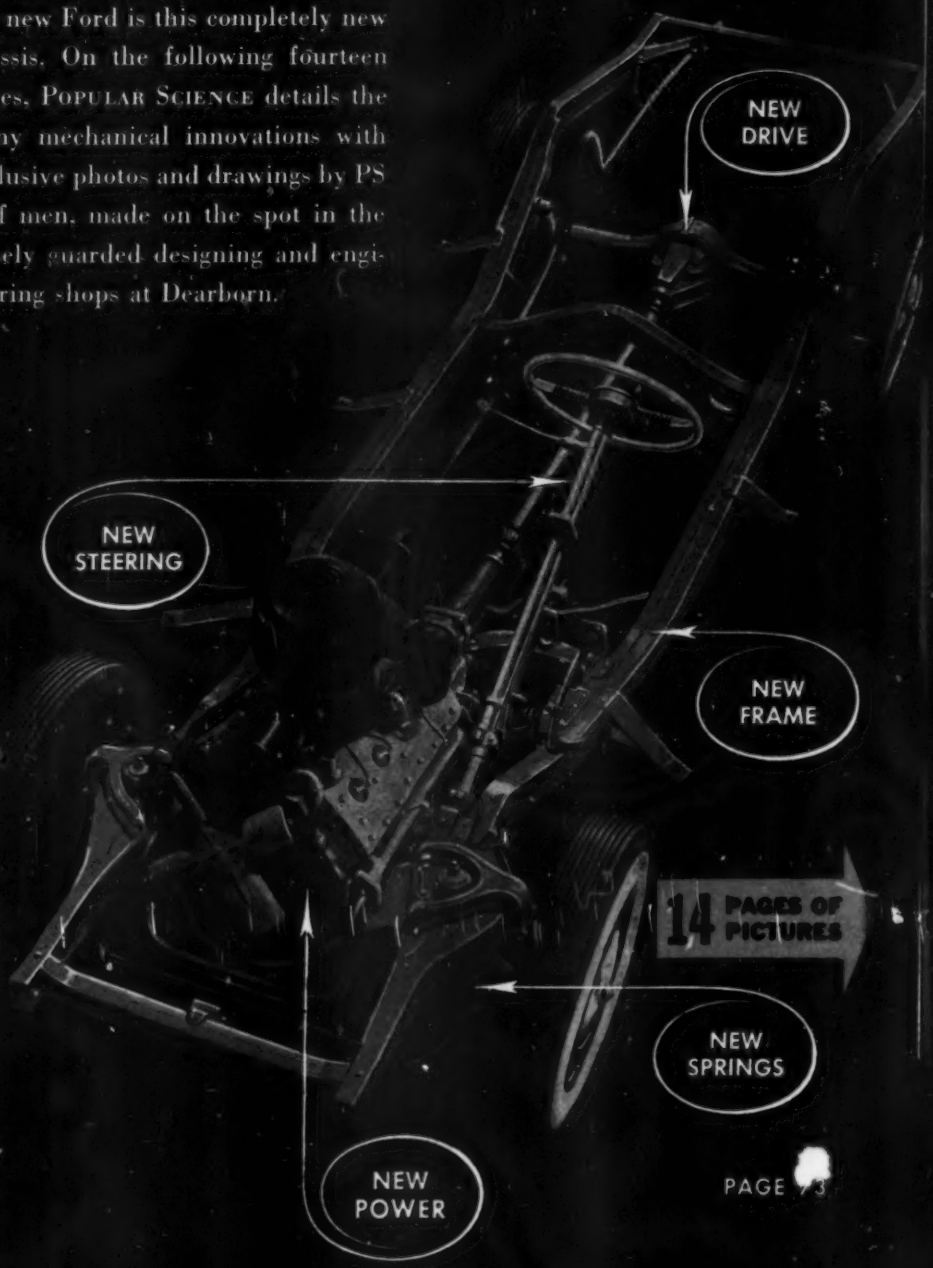

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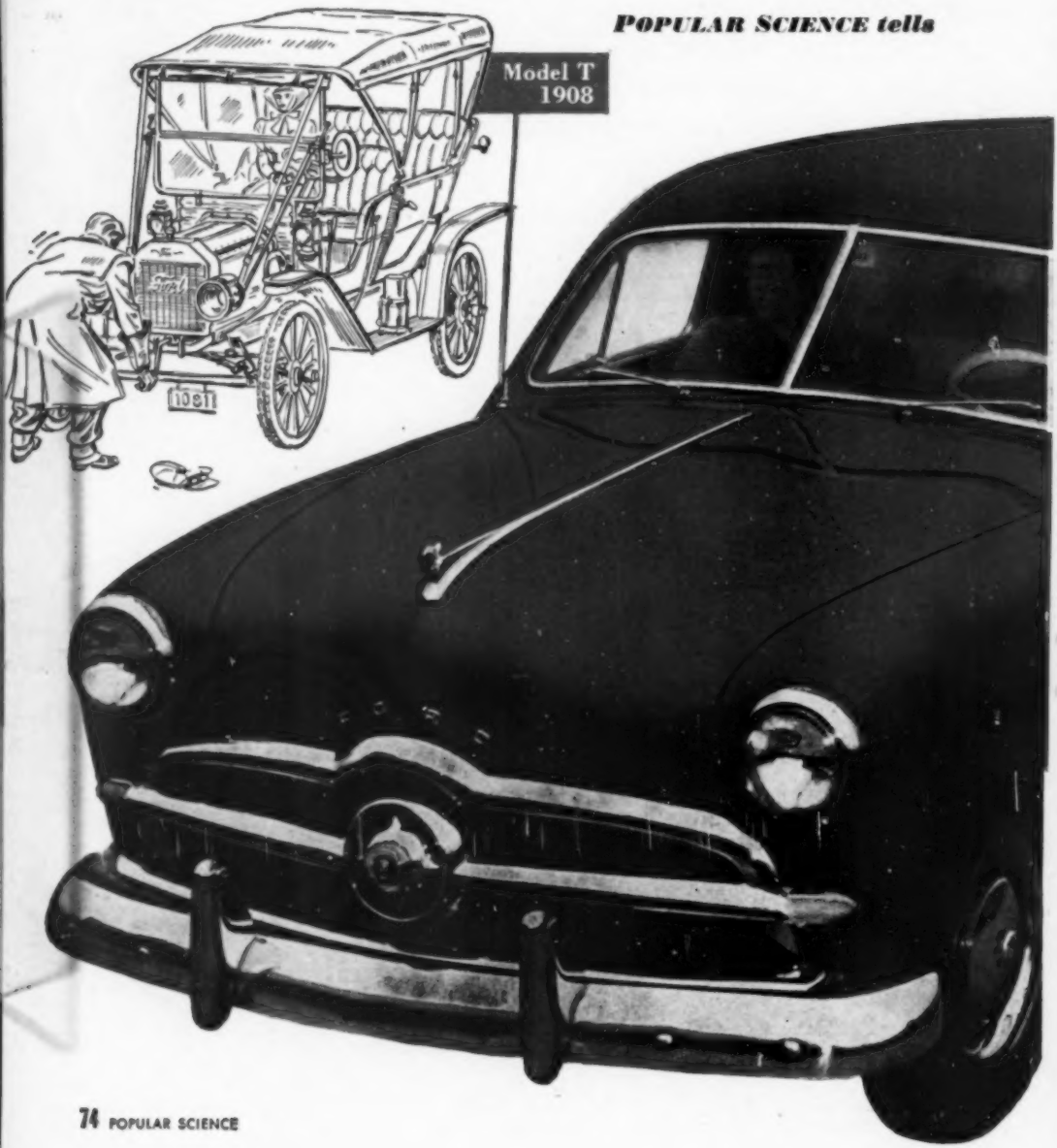
The Inside Story

POPULAR SCIENCE tells



of the New Ford

you why "only the name is the same" on the most discussed car on the road.

By Devon Francis

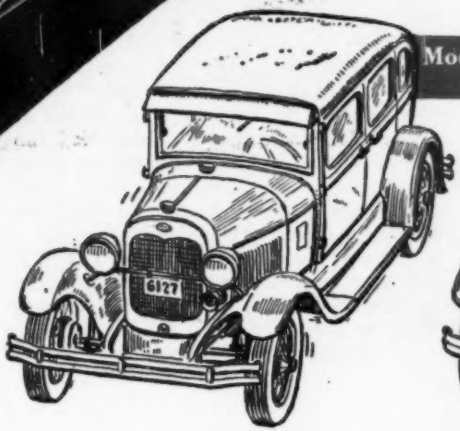
PS photos by W. W. Morris, on location
Drawings and sketches by Ray Pioch

IF you ask anyone at the sprawling Ford plant on the banks of Detroit's turgid River Rouge what changes they have made in the new Ford, he is likely to rub his chin reflectively for a moment. Then he'll ask, "Where do you want to start—at the front end, the back end, or the middle?"

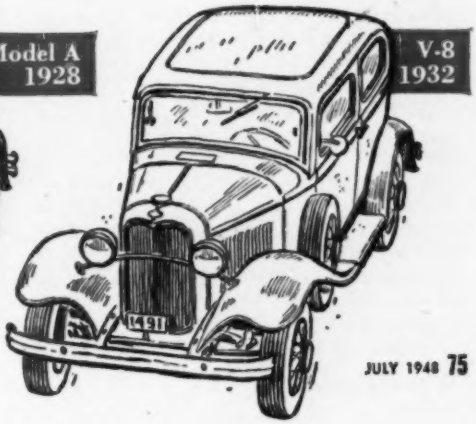
He would take an hour in the telling. After these many years, the Ford company, heirs of the greatest individual motormaker of them all, have produced an automobile that is new from bumper to bumper.

The third big revolution in design since Henry the First began issuing his Tin Lizzies with their brass radiators, clincher tires, and acetylene head lamps in 1908, the 1949 Ford belies its ancestry. In styling it is as advanced as anything on the road. It betters the fast pick up and high speed of its immediate forebear, Ford's postwar job. The springs and shock absorbers let you pound along at 60 over rough roads in comfort.

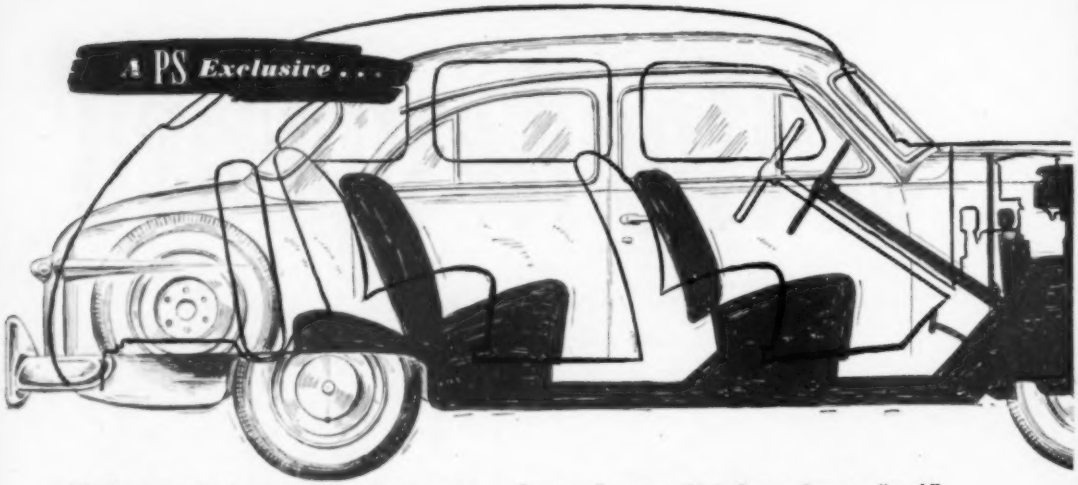
The stability lets you take a banked curve



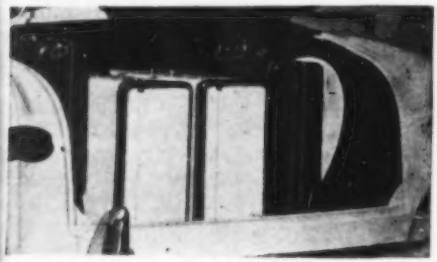
Model A
1928

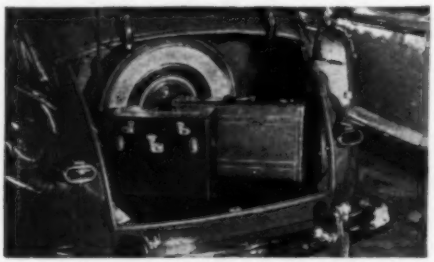


V-8
1932



All the new Fords except the station wagon have the "bustle back." The rear seat is entirely free of wheel well. The back of sedan's front seat is thinner so rear-seat passengers get plenty of leg room. Both engine and dash line are moved forward 5 inches. Car's over-all length is 196.7 inches, same as for 1948; width is a fraction greater – 71.7 inches. Equalizing tread front and rear at 56 inches makes car "track" better. Tread on '48 was 58 inches in front and 60 in rear. Body height of the '49 sedan is cut 4 inches, to 63, yet the new car has a bit more ground clearance and as much headroom as '48 model. This change in design lowers the center of gravity, minimizing sidesway and reducing the car's tendency to roll on curves.





Luggage capacity of 4-door sedan is more than half again as big. Comparison with old compartment (above, right) shows how space is used better in '49. Note change in spare-wheel well.

at 80 with one finger on the wheel. The engine is so quiet and vibrationless that when it idles you have to touch the accelerator to see whether it is turning over. The '49 Ford is the only car at its price with a built-in ventilation system.

And yet the combination of these improvements is not the most satisfying thing about the car. What is most welcome is its roominess. Without changing the "shadow" that it casts—without altering its length or breadth one iota—Ford engineers have created a spaciousness that would do credit to a bigger car. And they did it by making use of space that goes unused in the ordinary automobile.

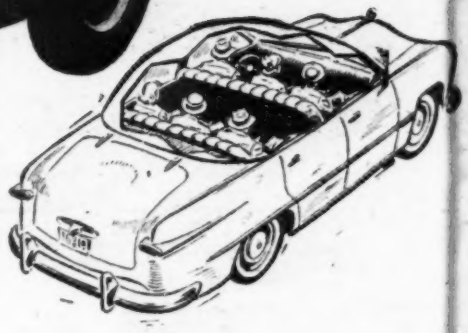
I had my tongue in my cheek when I went to Dearborn, Michigan, that pastoral suburb of Detroit which is the heart of the Ford empire, to see the new Ford. There had been changes in the Ford before. In former years the changes had been interesting. Some of them were spectacular. But if you got down on one knee and squinted at the machine's innards, you always saw the familiar transverse buggy springs. You knew the starter would whine as only a Ford starter could whine. You could count on fighting the steering wheel in high wind.

But now I've seen the '49 Ford. And if this piece on the car sounds prejudiced, the sin is innocent. I've driven it. It's the next thing to flying.

In the course of researching my story for

More room for everybody was designers' first goal.

Fenders, as forecast by PS (Nov. '46, pp. 66-72), are fully absorbed by body. Front-seat width is 61.5 inches, over 6 inches greater. Rear seat is 60, or 8 inches more. Shoulder room front and rear is 57.2 and 55.9 inches respectively. Wheelbase remains unchanged—114 inches. Blind spots are decreased by use of narrow corner posts. Sedan has 2,916 square inches of glass area, 12 percent more. Windshield area is boosted from 682 square inches to 819. "Curb weight" of car is only 3,150 lb., a cut of 220 lb. Lower weight trims cost of the car and gives more miles per gallon of gasoline.



POPULAR SCIENCE I ran an acceleration test. The readings had to be calibrated. All speedometers grow faithless as the speed goes up. Here were the results:

Seconds	Speedometer Reading	Actual Speed
3	10	10
4	20	20
6	30	29
8	40	38.6
12	50	48.1
16	60	58.1
22	70	68.5
30	80	78.6

"Pshaw!" said a friend in the seat beside me. "Look how you shifted. Bet I could shave five seconds off that!"

The car easily indicates 90 on a track built to take a top speed of 80.

"What's new on the new Ford?" I asked a test driver as we rolled to a stop.

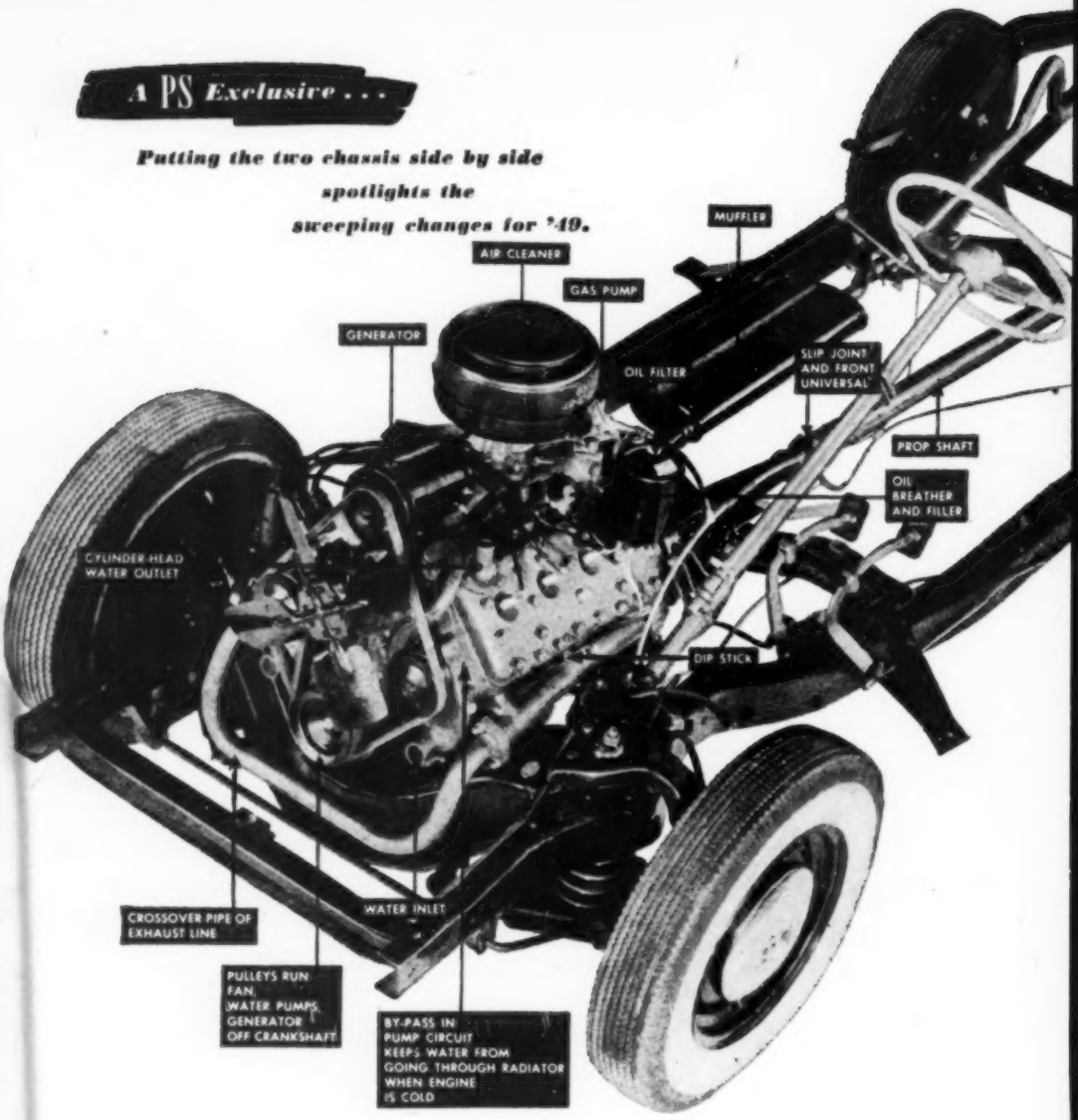
"New?" he echoed. "The frame, front and rear suspension, the engine, the body, the steering, the shocks, the transmission, the drive, the differential—."

I questioned a mechanic. "We haven't got a Ford any more, that's about it," he summarized.

It would be abusing the truth to say that in one fell swoop the new Ford has outdistanced its field. It is fair to say that it is pacing its field. But the Ford is only now catching up with its competitors on several counts of mechanical design. The Ford or-

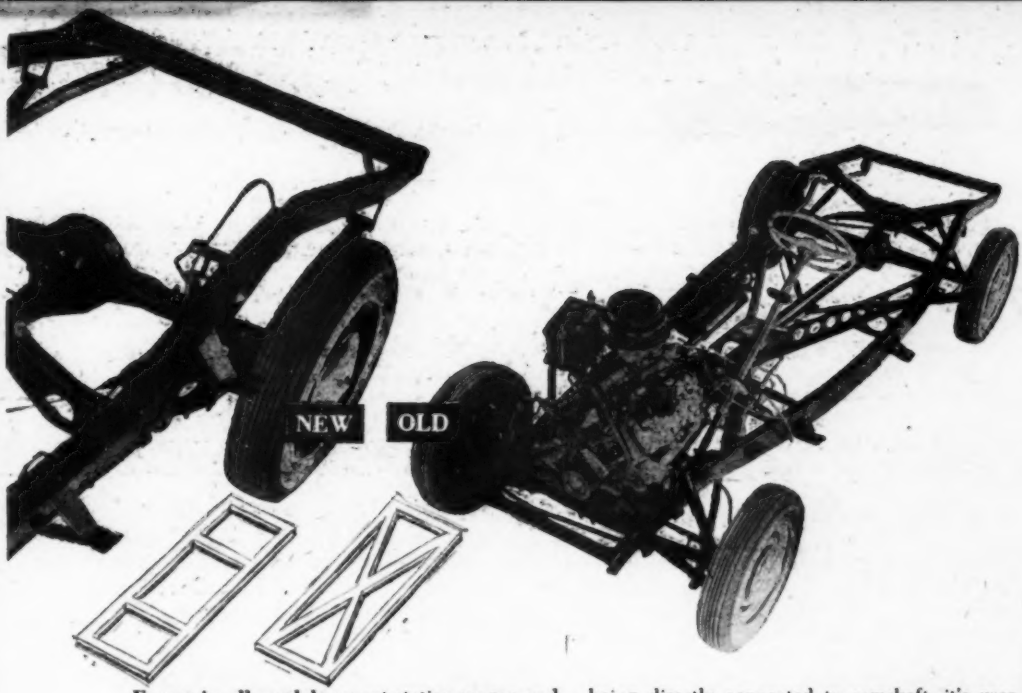
A PS *Exclusive . . .*

Putting the two chassis side by side spotlights the sweeping changes for '49.



ganization frankly admits that. Up to June of this year Ford was still using a rigid front axle when everyone else had gone to independent wheel suspension. It was still using the floating type of rod bearings. (The late Mr. Ford threatened to fire any man who tried to switch to the locked-in type.) While the engine ran cool, it contained hot spots that wasted power and fuel. A mechanic had to bang away at a wheel with a hammer to get it off, and pulling a transmission for repair was a job for two men and a boy. Worst of all, from a sales standpoint, the postwar Ford had anything but the New Look.

To compare the new Ford mechanically, then, with the Chevrolet or the Plymouth—or, in appearance, with the Studebaker, Hudson, or Kaiser-Frazer line—would be to use the wrong measuring stick. What Ford has done for '49 is reach the competitive taw mark and go on from there. The only way to get at the car is to compare it with its predecessor.



Frame in all models except station wagon and convertible is built-up, box-section ladder type with 5 cross-members. Elimination of old X member (right) reduced weight, permitted lowering body. Station wagon is of one-piece all-steel construction, for safety, with plywood veneer exterior. Sedan body is attached to frame at 22 points. Repairs and servicing are easier because of good accessibility. Oil-filter neck on engine has been moved forward and distributor brought from lower front center to above head on right cylinder bank. Instead of being directly connected to camshaft, it's gear driven. Solid valve guides reduce oil leakage. Exhaust yoke ends need to remove *two* tailpipes to "pull" an engine. Optional thermostatic fan on electric clutch slips until engine reaches 140° F. This helps warmup, boosts gas mileage. Braking problem caused by new weight distribution was solved by putting 62.3 percent of braking power in front wheels and 37.7 in rear. This matches a weight distribution on deceleration at 70 m.p.h. of 59.5 percent in front and 40.5 percent in the rear.

The new Ford is a Ford in name only. The company intended it to be just that when, in September 1946, the engineers and stylists were told to start doodling on a new car with their compasses and T squares. The car-to-be already had a name. It was known as X-2,900. The X was for Experimental, and the 2,900 was the number of pounds of weight Ford was shooting at. If the weight could be shaved to 2,900, it would be a saving of 500 pounds under the current model.

Less weight would mean lower manufacturing cost and more miles per gallon for the owner.

Time was important. Competitors would be on the market.

First of all, Ford took apart the competing cars. What did they have that the Ford didn't have? The Ford people had to admit that the answer was plenty. Three study chassis were ordered built. Possible body lines were chalked in, but the bodies could come later. Right now the chassis layout was the most important thing.

Right off, Ford decided that the 1949 body would have to be moved several inches forward. Already the men in charge of the project were thinking in terms of a "midship" ride for both the front and rear seat passengers. That would supply more luggage room too. But to move the body forward meant moving the engine too.

"You're going to get all that extra weight on the front wheels," warned the conservatives in the company.

"Yes," they were told, "we know. Let's take one thing at a time. We'll come to that."

The roof would be lowered. But how? You had to have frame depth for strength. You had to have road clearance. You had to have headroom. What were you going to

do with the propeller shaft to the rear axle—let the passengers straddle it? If you lowered the engine, it would squash right down on the steering linkage.

One thing at a time, counseled the men with a mind's-eye picture of the new Ford. Change the steering linkage. Change the frame. Change the brakes.

By November the study chassis were done. Gone was the familiar X stiffener in the frame. Gone were yesteryear's radius rods. Gone was the torque-tube drive. The engine had been shoved a full five inches forward over a brand new kind of steering linkage with a new "geometry."

Structural studies were made in the laboratory. They put excess weights and stresses on the hand-built chassis until it shattered. Everybody nodded. The frames were even stronger than the old ones. They hung 1947 bodies on the new frames and put them on the oval test track, screened from public view by a high board fence and a continuous thicket of evergreens.

The hybrids drove well. With a lower center of gravity, they were leechlike on the road. The new steering linkage eliminated any tendency toward "wind-wandering." The cars "cornered" well on turns. There was a lot of brake trouble on account of the new weight distribution, but that could be whipped. Some of the hybrids were put on the open road. They behaved well.

Next Problem: Body Appeal

But what about bodies? There was a problem. A mistake in styling could ruin the project. The public won't buy something it doesn't like the looks of.

They made up some seating bucks (PS, Nov. '46, pp. 66-72), with roughed-in windshields and fenders. There was lots of interior room. That was the way it would have to be. By December the acceptable body styles had been reduced to two and the full-size clay models had been built up.

"No Ford in those," remarked one company official, grinning.

In the design finally chosen, by vote, body width had been pushed clear to the outer edges of the vestigial running boards. A "bustle back" made even the 4-door-sedan model look as natty as a coupe. There was leg room fore and aft. From the front of the hood to the tips of the tail lights, the lines, were poetry in motion.

It was not until the latter part of July, 1947, that the first of the hand-built, complete 1949 Fords were put on the test track. The new cars, deliberately smeared with mud, streaked with stove blacking, and with all means of identification removed, were put on the highway.

Onlookers got curious. On one occasion a new Ford was caught in standstill traffic. Neighboring drivers slid from under their wheels and sauntered over to take a close look at it.

"Maybe it's a Studebaker," ventured one, "but I don't know." His brow puckered. "Is it a Studebaker?" he asked the Ford driver.

"Yes," replied the Ford man.

Recognition was not the only risk that Ford ran in testing its '49s. On the track some of the drivers, with their hands on a vehicle that accelerated like a jack rabbit and rolled like a hurricane, had to play cowboy. Bodies were dented. The engineering department raised Cain. New Fords were few, and there was work to be done.

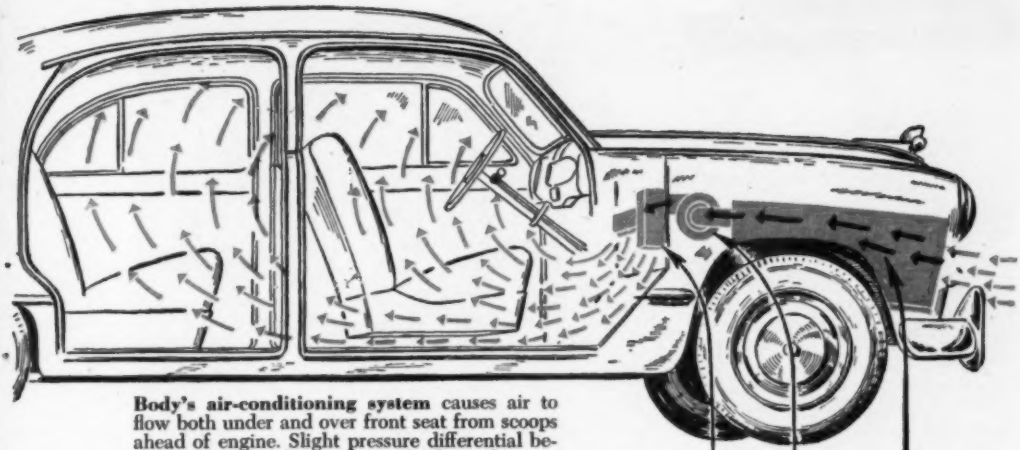
Designed in Record Time

It was just 14 months after draftsmen began drawing pictures on paper that Ford was substantially satisfied with its new car. That was a record. Usually it takes two to two and a half years to produce the pilot models of a brand new car.

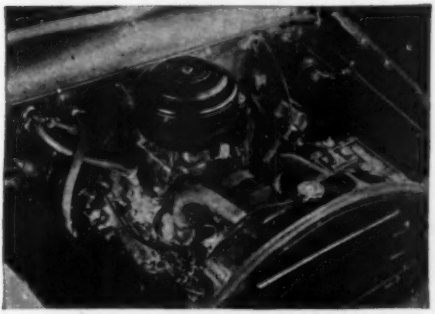
Ford had missed its mark on weight. The car was not 500 pounds lighter. That was because there wasn't the time to re-do the engine completely. But, at that, the weight of the '49 Ford was considerably beyond 200 pounds under current models.

Even while the Rouge plant, amid the heat of its blast furnaces and the clanging of its drop hammers, was tooling up last spring for the manufacture of '49 Fords, the engineering department was still making last-minute changes. A car that had cost many millions to develop had to be as perfect as human resource could make it. Tooling was expensive too. That was costing $37,500,000.

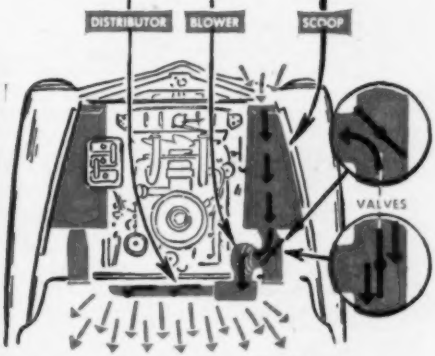
The man who sparked the development of the new car bears the same name as the man who built the first Ford. Henry Ford II, grandson of the inventor who in the formative years of the century did more than any other manufacturer to put America on wheels, is young. He won't be 31 until September. In the backwaters of the Rouge



Body's air-conditioning system causes air to flow both under and over front seat from scoops ahead of engine. Slight pressure differential between inside and outside air built up by ram effect when car is under way keeps the windows from frosting during cold weather.



Position of scoops assures fume-free air. Three-way valve at blower directs air passage straight into car body, through blower to heater, or shuts off air from intake and permits body-interior air to be recirculated through blower and heater for reconditioning.



There are actually two air systems. Left one provides fresh air only and is controlled by manually operated outlet. Right one can supply fresh air too, but also can be manipulated to divert air to blower and heater as described at left. System eliminates old cowl ventilator.

he is known as "H.F. 2" or "The Deuce." The terms are not derisive. Young Henry has shown marked administrative abilities and a willingness to turn his back on tradition.

The story goes that soon after he assumed the presidency of Ford in 1945, he walked along the assembly line slamming the doors of his cars. They were just as strong, just as well hung, as those of his competitors' cars, but their acoustics were bad. They sounded tinny.

"That," remarked young Henry, "has got to be changed."

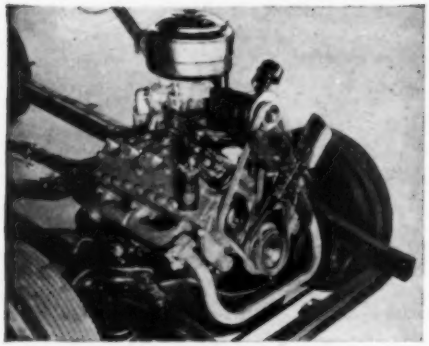
It has been. Many other things have been changed too. The first great revolution at Ford was the switch from the Model T to the Model A in 1928. The second was the V-8 in 1932. As architect of the third, young Henry has outdone his grandfather.

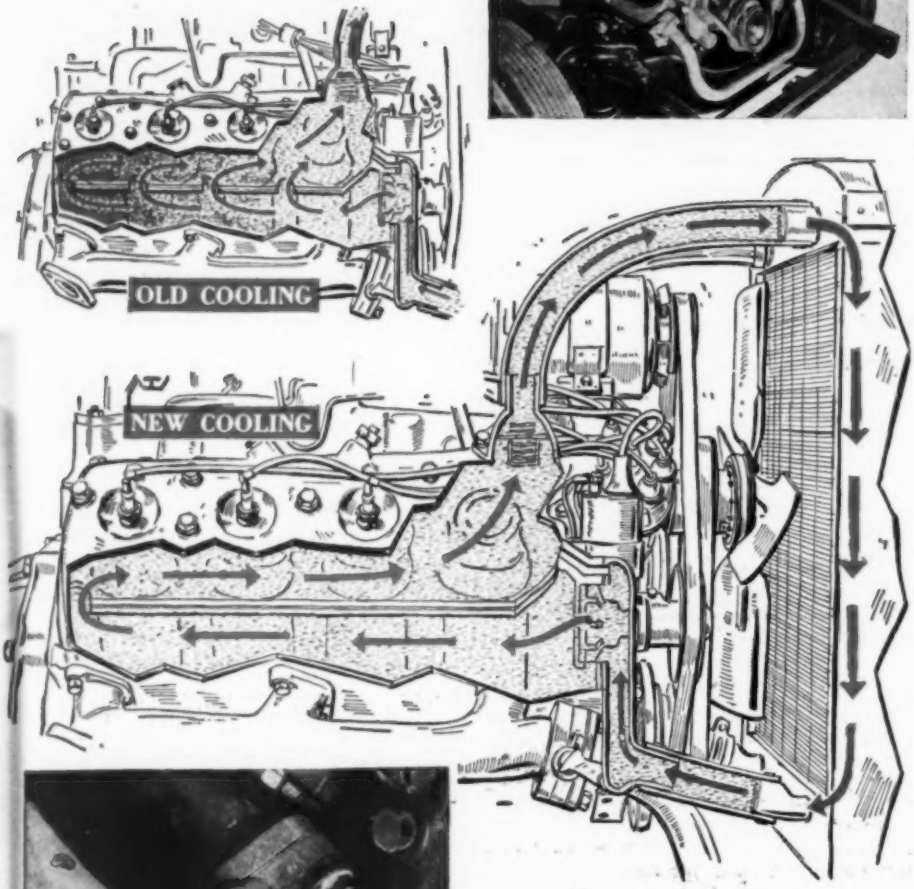
Yet, when I slipped behind the wheel of the new Ford for the first time I felt somewhat sad. I had driven a Ford for the first time in 1917. My memories of it were tender. That old planetary gear system and the front wheels that always wanted to wander off the road had something that no amount of brilliant engineering in this day could supplant. This break with tradition was too sharp.

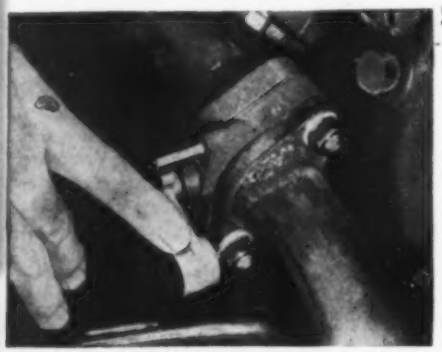
Then I pushed the starter button. The familiar Ford starter whine smote my ears. Somehow I felt a lot better.

A PS *Exclusive . . .*

New Ford engine eliminates an old cooling bugaboo.

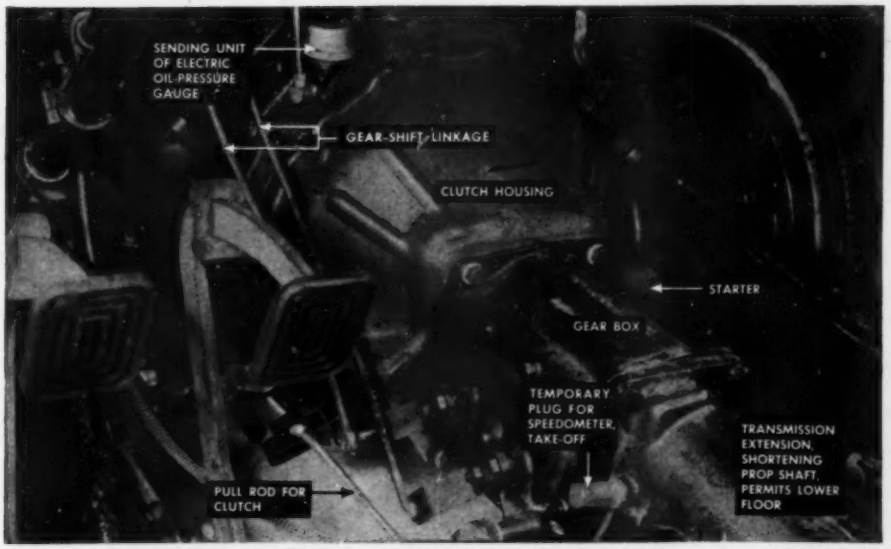




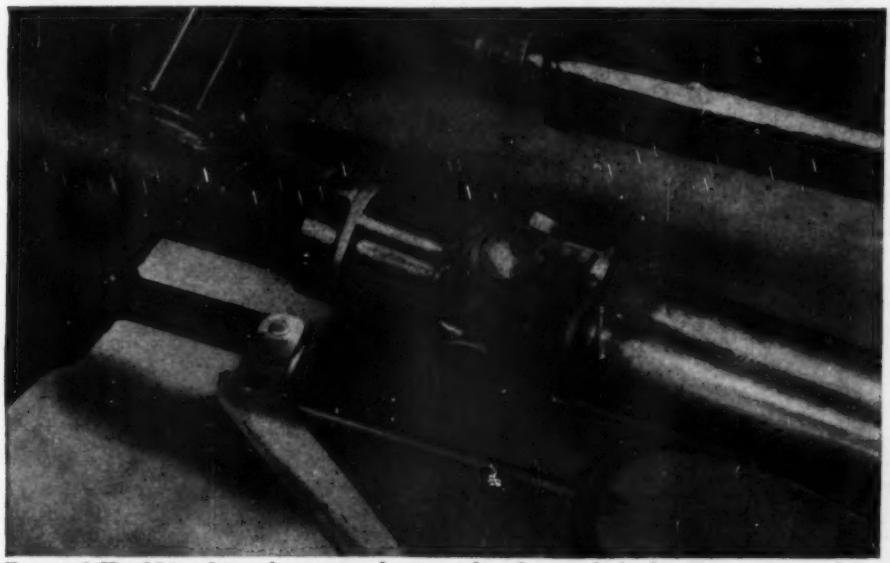


Thermostatic valve behind exhaust yoke on right side reroutes gases through passages around intake manifold to speed warmup.

New cooling system lowers running temperature by 12°. Cool water is pumped straight to rear of block, up to cylinder head, and back to radiator. Equalizing cooling from end to end reduces temperature differential between front and rear of engine to 4°, controlling hot spots. Heat dissipation is speeded also by the cooling system's highly turbulent water flow. New Ford comes with either V-8 or 6-cylinder in-line engine. V-8 is rated at 100 hp. at 3,800 r.p.m., the 6 at 95 hp. at 3,300 r.p.m. Compression ratio of each is boosted to 6.8 to 1. Bore and stroke of the V-8 are 3 3/16 and 3¾ in.; those of the 6-cylinder engine, 3.3 and 4.4 in.

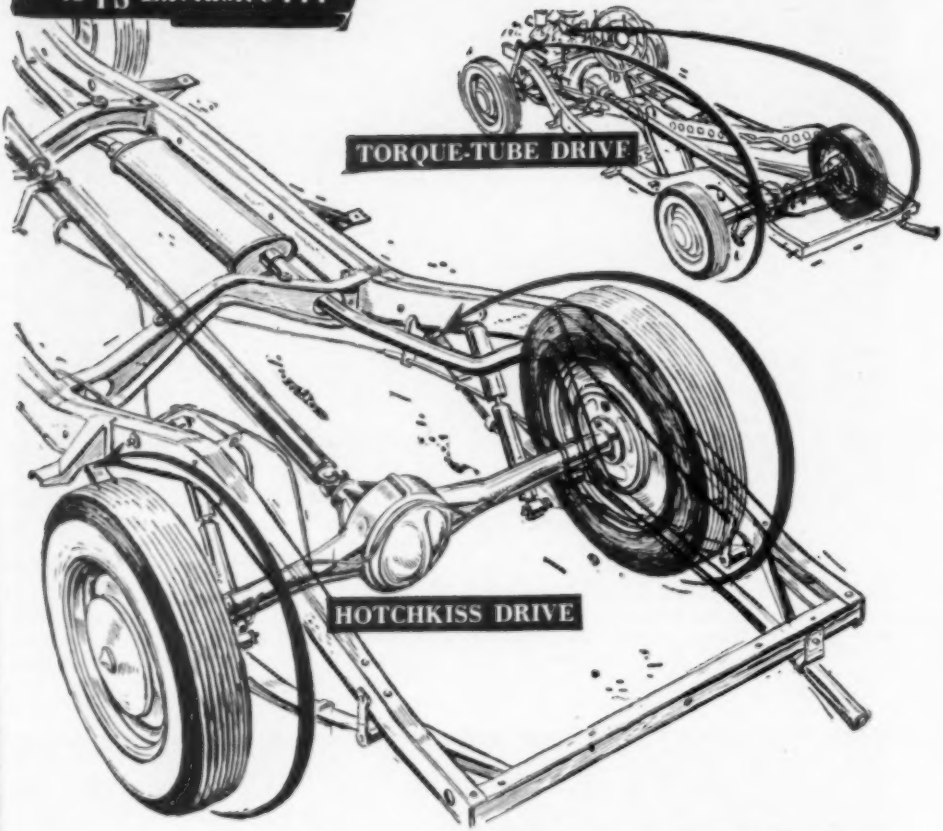


Ford has "bob-tailed" engine by casting block separately from clutch housing. Behind clutch is transmission, held by only four bolts, and 16-inch transmission extension used to shorten propeller shaft and make room to lower body floor. Intake and exhaust noises are reduced by redesign of air cleaner, manifolding, and muffler system. Distributor control for spark-advance regulation is operated by vacuum only, instead of by old dual system of vacuum and centrifugal force. This eliminates governor and plunger in distributor. Opening in clutch housing, with timing marks on flywheel and housing, permits more accurate timing. Engine oil pan, clutch, and transmission can now be taken out without removing engine. Transmission extension can be replaced with an optional overdrive with 2.87 ratio. Its use cuts engine wear considerably and increases gas mileage. The overdrive engages when the car is traveling at 26 m.p.h.

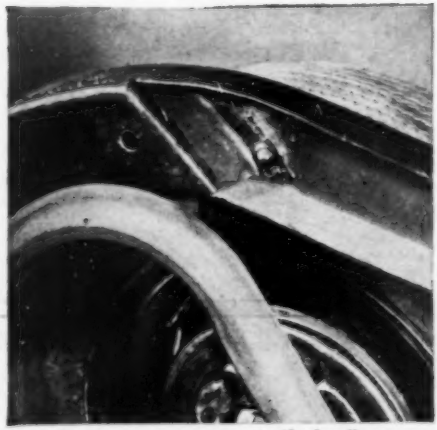


Front of Hotchkiss drive shows one of two universal joints and shaft that is free to slide in and out of transmission extension as rear axle takes road shocks. New system reduces weight, permits lower frame height, gives greater riding comfort, and reduces clutch chatter.

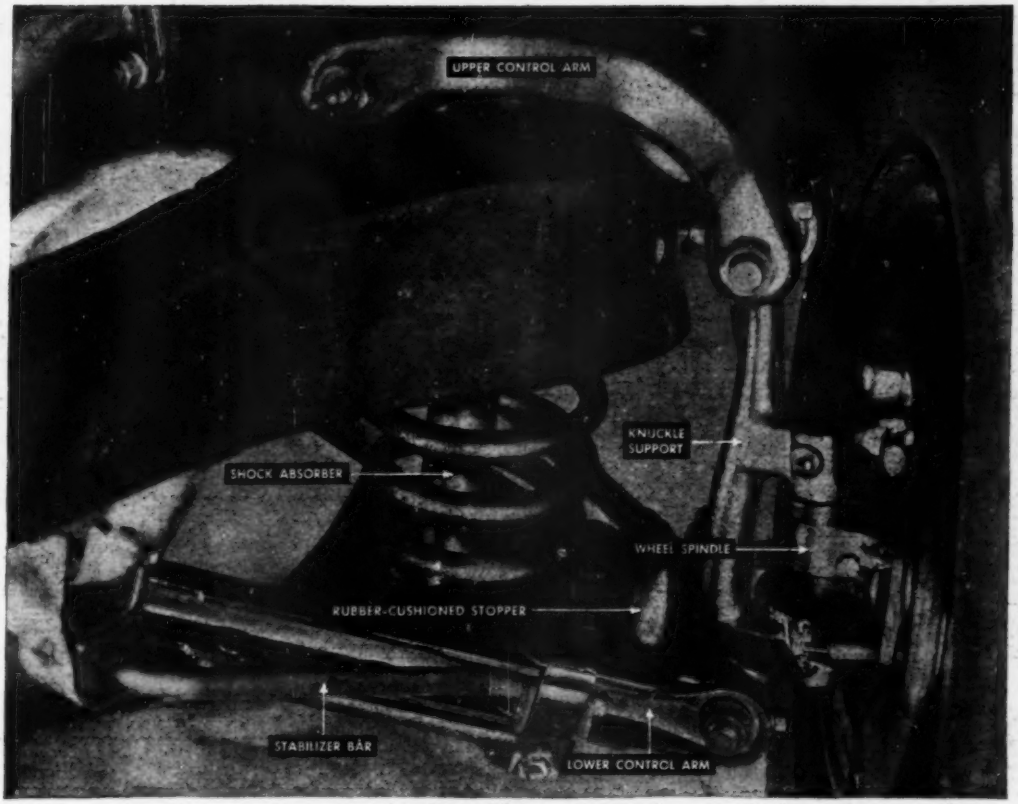
A PS *Exclusive . . .*



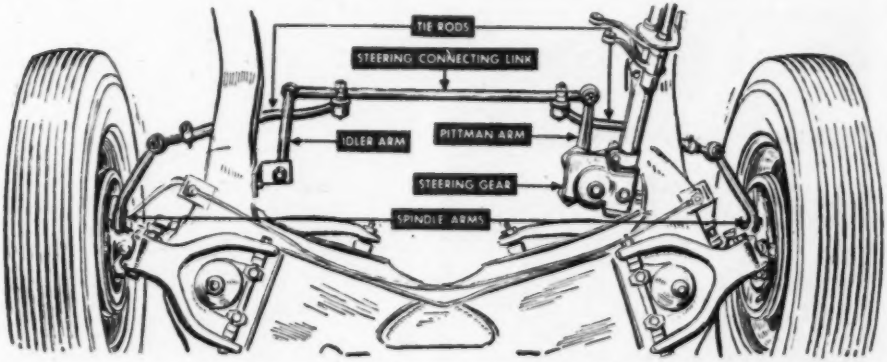
New drive incorporates semi-elliptic rear springs, replacing old transverse "buggy" spring. All driving and braking forces between axle and frame are transmitted through springs instead of through the radius rods and torque tube that have now been discarded. This gives more comfortable starts and stops. Cushioned engine anchorages are now only to hold engine in cradle instead of to transmit push of rear wheels to frame. This helps insulate body from engine vibration. Springs are 50 inches long and 2 inches wide. Shackles and spring eyes have compression-type rubber bushings, require no lubrication. Leaves have liners between them. Differential assembly can be replaced simply by pulling out axle shafts and disconnecting propeller shaft at rear universal. Use of hypoid instead of spiral bevel gearing lowers drive line 1½ inches at rear and reduces tunnel height necessary in rear of body. Rear-axle ratio is 3.73 to 1, with 3.54 or 4 to 1 optional. Wheels have 4½- instead of 4-inch rims, carry 6.00 x 16 4-ply tires. Rear wheels are bolted directly to rear-axle shaft flanges, and shafts are supported by ball bearings in outer ends of axle housing.



Box frame is continuous to "kickup" at rear axle. Exceptionally rigid, frame is even more resistant to twisting and bending than X-type it replaces. Tube in picture is exhaust pipe.



Heavy cross-member is used at front of frame to provide for new individual wheel suspension. Telescopic shock absorbers held by only two nuts are mounted in center of coil springs. Shock units can be replaced without jacking up front wheels. There is no danger, either, of upsetting "geometry" of steering or misaligning front wheels. New steering eliminates "wheel fight" on rough roads. Upper and lower support arms for frame are clearly visible. Small transverse rod at lower part of photo is 11/16-inch stabilizer bar. None is used at rear.



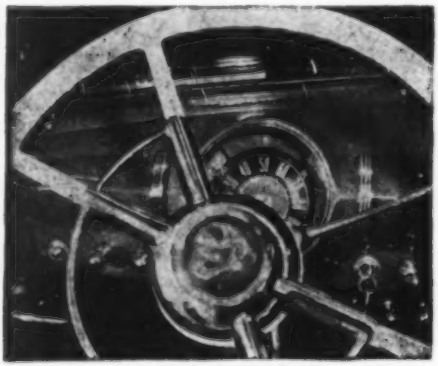
Parallelogram type of linkage is used on steering. Improved geometry reduces tire squeal often associated with independent wheel suspension and boosts tire mileage. Because pivot point of tie rod is on same center line as that of wheel suspension, linkage and wheel move through same arc when wheel strikes bump. This assures constant correct adjustment.

Hinging both doors at front is a safety measure. Slightly thinner body walls and doors below belt line help increase interior space. Window area is 101 square inches more than last year.

Chrome strip is intended to take shock if door from an adjoining car is opened against the body. As in all the new cars, a dented fender means a body job in the repair shop.

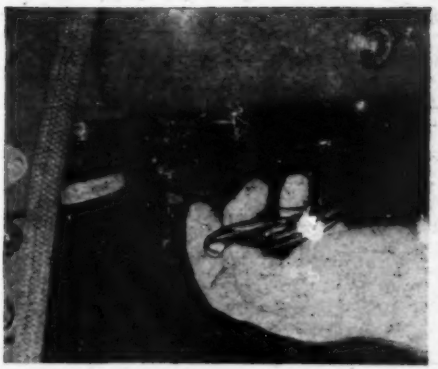
Door handles are of pull type. Push buttons on molding lock doors from inside. You can't lock door from outside, however, without key, so you can't snap-lock yourself out.

Rest of hardware is conventional. Dum-dum deadener applied freely throughout body keeps squeaks, rumbles at a minimum. Maximum inside body width at belt line is 3 inches greater.

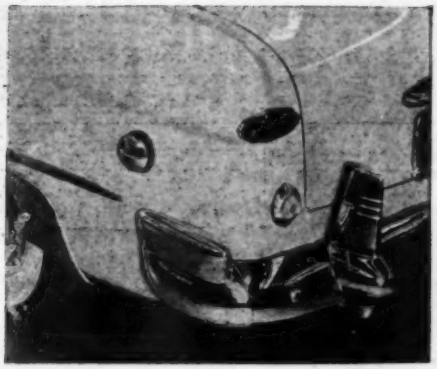


Controls grouped behind wheel are starter, windshield wiper, lights, fresh-air vents, ignition, choke, defroster, temperature, heater switch. Four-spoke wheel is extra.

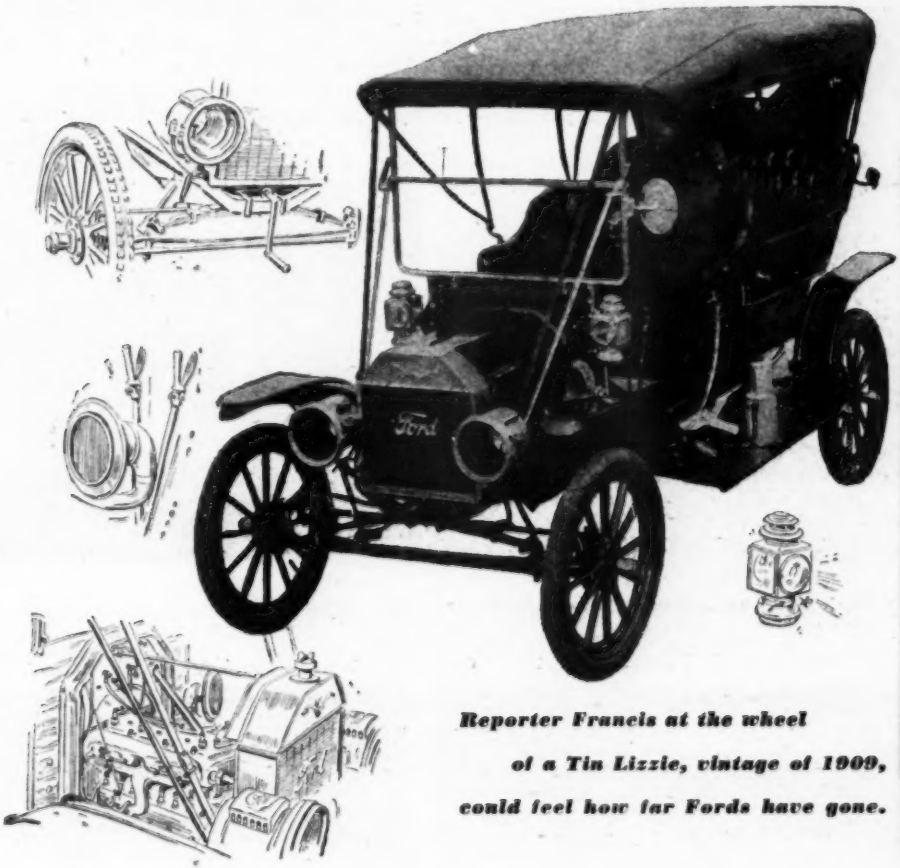
Fuel level, oil pressure, engine temperature, and charge-discharge battery indicator are grouped around speedometer within single housing. Radio and clock are optional.



Parking brake is direct-pull type. On panel above it is button, located left of steering column, for starting engine. Hood-release mechanism is just to the left of brake handle.



Ford will stress available optional equipment this year. Here the backing light, the bumper wing, the bumper guard, and the metal frame for license plate are all optional.

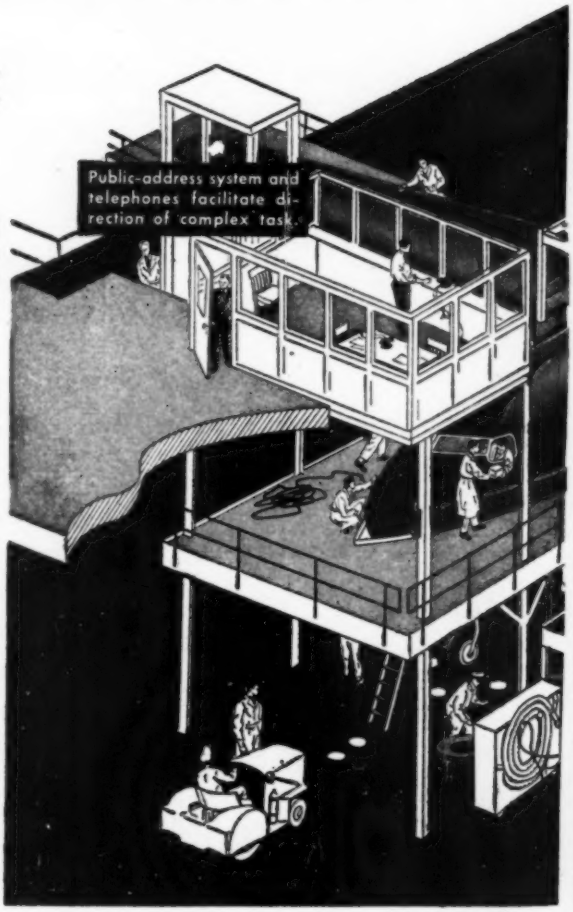


Reporter Francis at the wheel of a Tin Lizzie, vintage of 1909, could feel how far Fords have gone.

Laying 100 Hands on a Plane

This new workbench for big air liners permits mechanics to swarm all over them for a high-speed overhaul.

Drawing by Ray Quigley

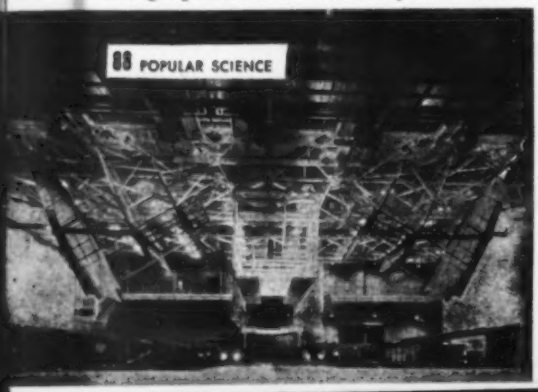


TEN minutes after a DC-6 enters United Airlines' new maintenance base at San Francisco, it ceases to be a flying machine and becomes part of a sturdy, many-balconied building. The huge plane can then be taken apart as quickly as a circus tent.

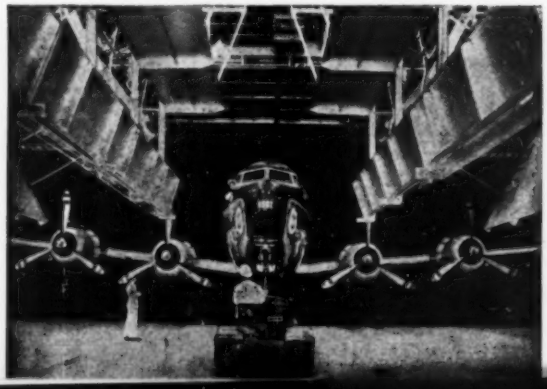
Fifty men can work on the plane at once, almost as effectively as though each part were clamped in a vice on a separate workbench. Examining, cleaning, repairing, and painting the wings, fuselage, and tail are no more difficult or dangerous than refinishing your kitchen wall. And from this immense mechanical maze, propellers, engines, instruments, hydraulic apparatus, and cabin furnishings can be whisked off to nearby shops so completely equipped and highly mechanized that they resemble auto factories.

About four times a year, a tractor will tow each one of United's 70 four-engine DC-6 and DC-4 liners into this modern fountain of youth. The plane's nose will fit snugly into a permanent platform, jacks will lift the weight off its landing gear, and metal scaffolding will be wrapped snugly around it. Then, in about 20 percent less time than formerly was needed, the big liner will be so thoroughly overhauled it will roll back to the runways looking and acting brand new.

1. This 130-foot-wide, 35-foot-high dock is the entry to United's new 116-acre shops for overhauling huge air liners. A 6-hp. motor swings up its 25-ton steel door in just 15 seconds.



2. Pushing buttons will swing this mass of scaffolding around the liner. Catwalks will fold down alongside the fuselage, and a ramp will rise from the floor to the sill of the cabin door.



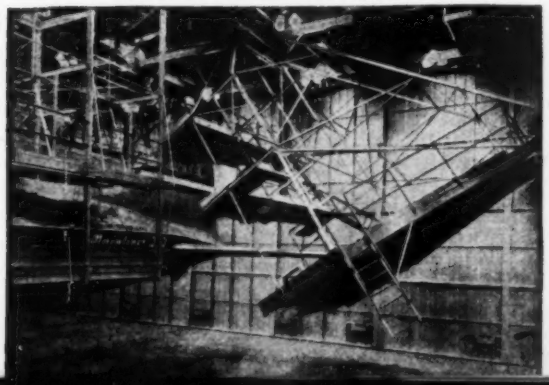
Three platforms make it easy to reach any part of the 30-foot-high tail.

Upholsterers and cleaners go over interior without stumbling over mechanics.

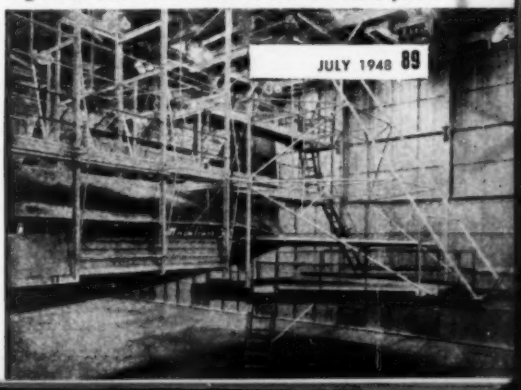
Lights in floor of this sloping platform illuminate underside of the wing.

Electric hoist being used to remove 352-lb. propeller also makes it easy to walk off with an engine.

3. A ton of framework descends from the ceiling around each side of the plane's tail. Enough light for nearly 2,000 average homes is required to illuminate this gigantic base.



4. Nobody has to scramble over the plane. Every part can be reached from a safe platform. This dock will also accommodate the big Boeing Stratocruisers scheduled for use next year.

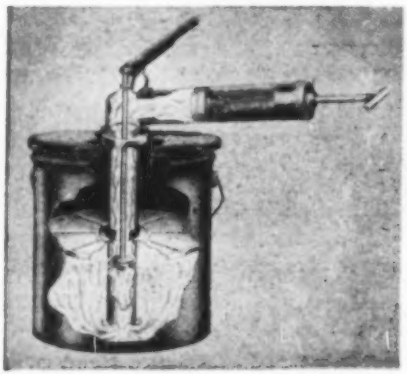


Cleaner Hangs Up

A HANDLE hinge that opens out flat lets this new Singer vacuum cleaner hang against a closet wall. The fan and motor housing, only five inches thick, can go under lower furniture than most cleaners. This low profile is made possible by use of a horizontal motor with a shallow-pitch fan on each end of its shaft.

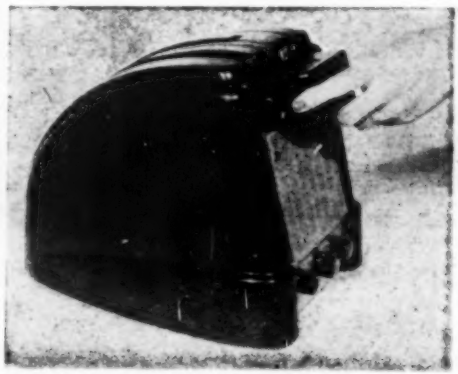
Breeze Spreaders

THE workmen above are installing one of the new axial-flow fans that are being tested this summer in New York subway cars. Ten blades push air through five diffusion rings that spread it uniformly over the car, instead of blasting the breeze directly down a few riders' necks. The fans, made by Westinghouse, are thermostat-controlled to run faster on hot days.



Pump Saves Grease

A NEW pump to load grease guns gets every last gob out of the pail. As shown, a follow plate is sucked down inside the pail as grease is pumped out, scraping the can and sealing it against dirt. Comet Equipment Co. makes the pump.



Cartridge Loads Recorder

YOU can load this RCA wire recorder like a gun: just slip a cartridge into a slot, as shown above. Both bothersome threading and rewinding delays are eliminated: the cartridge holds two wires that run in opposite directions, one rewinding while the other is in use.

Flying in Red and Green Air

Colored pellets—red for down, green for up—in the tubes of the patented variometer at right show a pilot whether his sailplane is losing or gaining altitude. The instrument, operated by air pressure, registers changes of as little as 3 feet.

Sailplane pilots learn flying in its purest form by chasing up-currents to ride skyward like a soaring bird.

PS photos by W. W. Morris

LATE last month several scores of men and women jounced by automobile and trailer into the hill-hedged community of Elmira, N. Y., on a strange quest. They were starting a hunt for green air. For a certainty, they would find red air too.

For these were glider enthusiasts, ready for a fortnight of motorless flight at the annual National Soaring Contest in the world's best craft for learning to fly. "Green air" is their name for up-currents to lift their planes aloft. "Red air" is down-currents, which they try to avoid. The names come from the altitude-change instruments in their cockpits; these contain pellet indicators colored red for down and green for up.

"Lot of green air today," a pilot will say, beaming, as he lands after a long flight. Or, complaining, "The air's red all over."

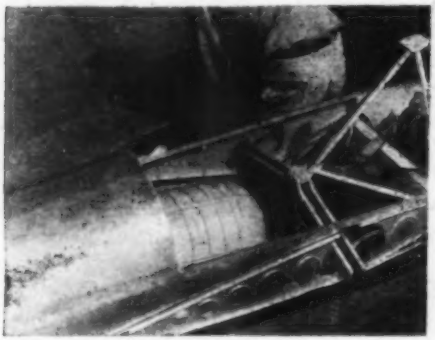
Flying in red and green air is a sport, and an expensive one: a fine sailplane, man's most graceful mechanical creation for flight, retails for around $3,000. Soaring is also a science—one far more complicated than operating a light powered airplane.

And because it gives a pilot the feel of his element, learning the science of soaring is good flight training. For soaring depends, as most everyone knows, on upward currents of air, called thermals, caused by uneven heating of the earth's surface, or by air being bounced upward when winds hit hills or mountains (PS, June '46, p. 104).

But the tricks for riding those currents of air, the novice at motorless flight soon learns, are full of contradictions. When a pilot tries

Sailplane arrives at Elmira, N. Y., in auto-towed trailer. Wings and horizontal stabilizer rest in specially designed nests. Crew member lets down tailgate to begin assembly of plane.

Stabilizer is fixed in place simply by screwing three nuts on permanent bolts and attaching fairing by half-turn fasteners. Plane is a Schweizer 1-21 of unusually high performance.



Wings are attached with nuts and so-called safety pins. Controls for ailerons, elevator, dive brakes, spoilers are connected with clevis pins. Rudder controls were not detached in transit.

Hatch goes on to complete assembly job. Tripod protects pilot if plane overturns on the ground. Bomblike object is oxygen bottle. Experienced crew can assemble plane in 15 min.

for distance—the international record, held by a Russian, is 465 miles—he is likely to pour upward of 30 gallons of water into his wing tanks: a motorless plane flies better when it is heavier, even though it is buoyed up only by air currents. And a soaring pilot has more need for an oxygen mask than a lightplane pilot: the international altitude record, held by a German, is 23,434 feet, and the average soaring pilot cruises thousands of feet higher than his lightplane comrade.

Even the best glider pilots still have much to learn about soaring. Only lately has the "standing wave" in mountainous country been discovered. When wind hits a high mountain ridge, it flows over and down the other side—and there, unaccountably, a tremendous upward wave develops. Pilots have soared to great heights on such waves.

Lately, too, pilots have worked on what they call dynamic soaring. Birds soar dynamically by sensing a coming gust. A gust boosts a plane's air speed. The bird's trick, not yet mastered by man, is to anticipate the gust, raise its nose, and gain altitude when the gust hits.

Soaring pilots, like windjammer sailors, have a peculiar pride in their art. Soaring, an enthusiast will tell you, is flying at its purest, since it does not depend on aid of an engine. Most pilots "fly power"—depend on propeller thrust. What soaring could teach them was pointed up in a remark made the other day by Shelley Charles, crack pilot of Eastern Air Lines and holder of the American motorless altitude record:

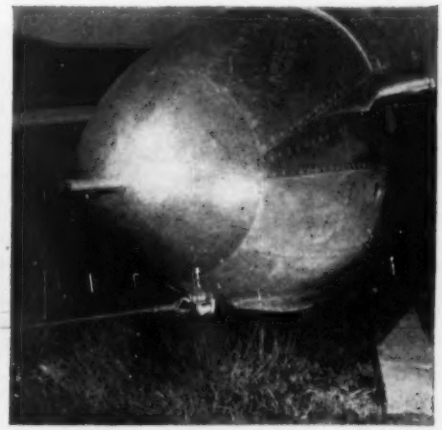
"When you learn to fly a wing instead of power, you gain new confidence in your airplane. Even if I lost all the engine power on an airliner, with glider knowledge I'd have no fear and would feel much better about landing safely." END

With cockpit canopy on, the Schweizer is ready to fly. It has a gross weight, with ballast, of 990 pounds, a wing span of 51 feet, length of 22 feet 1 inch. Its maximum cruising speed is 85 m.p.h. The landing gear consists of a 13-inch pneumatic front wheel and a solid-rubber tail wheel. A five-foot skid with a steel shoe under plane's nose serves as a ground brake.

Two tanks hold 34 gallons of water for ballast. Increasing the sailplane's weight provides greater forward speed at a lower gliding angle, thus permitting flights of greater distance.

Instrument panel, more complex than in lightplane, has two variometers, oxygen blinker, pitch indicator, spoilers control, tow-cable release. Knob at far left is for the dive brakes.

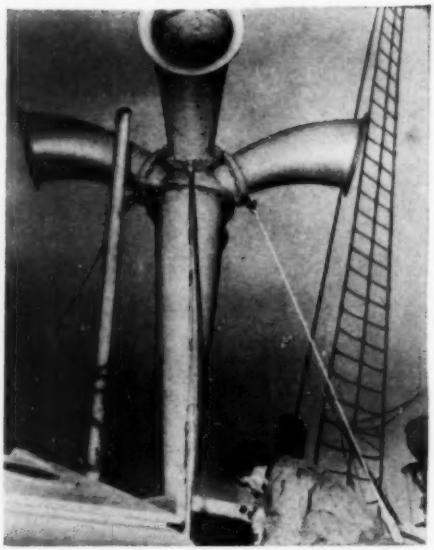
Dive brakes (right) open above and below wing for quick descent at reduced speed. Spoiler, inboard, disturbs flow of air over top of wing to reduce lift and aid in "spot" landings.



Patented hook under nose secures and releases tow cable. Takeoffs are made by towing glider with car or airplane. Tow planes charge $2 for first 1,000 ft., $1 for each additional 1,000.

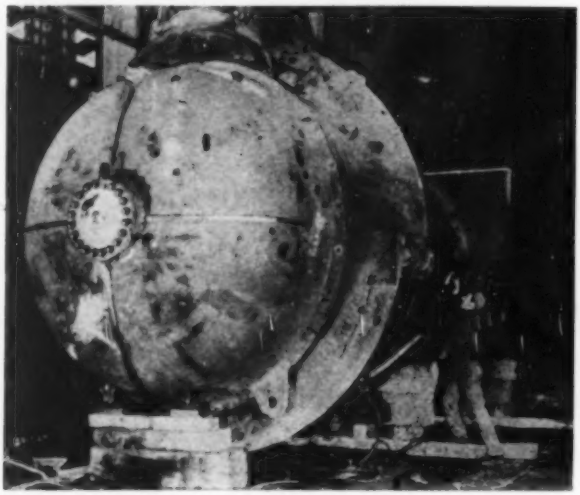
Crane Sets Up Wall

WITH this compact crane, one man can raise a whole concrete wall into position. The crane's "hook" is a plate that bolts to the edge of a concrete slab precast in a horizontal form. The mast is formed by two I-beams welded to a steel pipe that serves as a hinged base. When the winch is turned, rollers on the plate run up the underside of the beams, setting the slab on edge. The Portland Cement Assn. developed the crane as a labor saver.



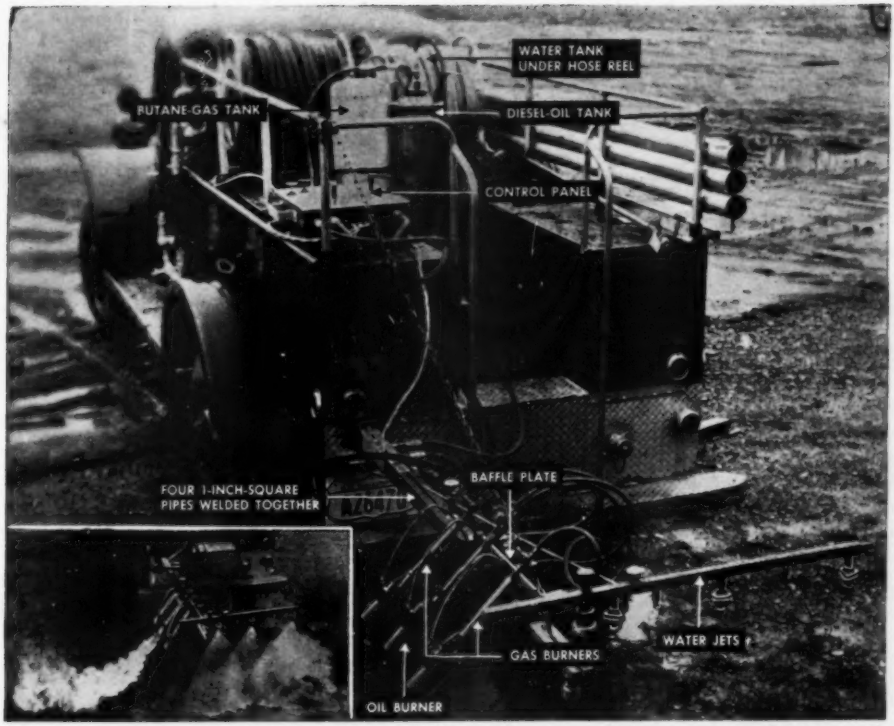
Huge Horn Guides Ships

THIS man-made mushroom is the foghorn that booms out from the upper deck of Ambrose Lightship to guide vessels into New York Harbor in soupy weather. Its hoarse shout, formed by steam blasting under high pressure against vibrating disks, carries five miles. When visibility is down to that range, the horn is sounded for three seconds, five times a minute. The ship, manned by the Coast Guard, also has a light visible 14 miles and a 100-mile radio beam.



Navy Gets Big Pressure Room

IN THE steel chamber at left, the Navy now can test underwater equipment at pressures up to a ton per square inch—the same as a mile down at sea. It's 40 ft. long, 9 ft. in diameter, and has walls 3 15/16 in. thick. The rounded end comes off to admit large pieces of equipment. The 220-ton drum had to be shipped on a special railway car from Barberton, O., where it was made by Babcock & Wilcox, to the Naval Ordnance Laboratory at White Oak, Md.



Pump truck throws flame to set backfire while wetting strip of grass to control its spread.

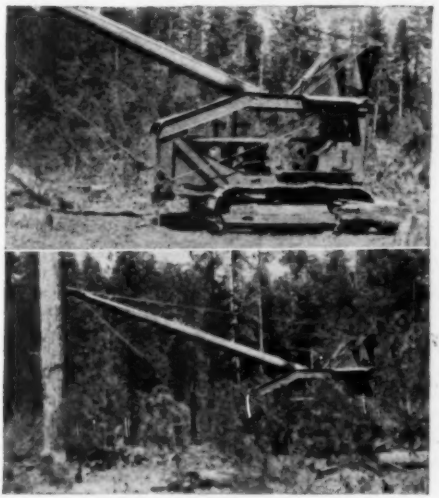
New Machines Fight Forest Fires

THE U. S. Forest Service is arming its rangers with two new mechanized weapons for their unending war against fire.

One, shown in action at right, helps to prevent fires by clearing timberland of dead trees. The other, pictured above, speeds the setting of backfires to keep grass fires from spreading.

A standard pumper truck fitted with a flame thrower to set the backfire while rolling along at 8 to 10 m.p.h., the machine has a battery of water jets that simultaneously wet down a strip of grass behind the backfire to keep it under control.

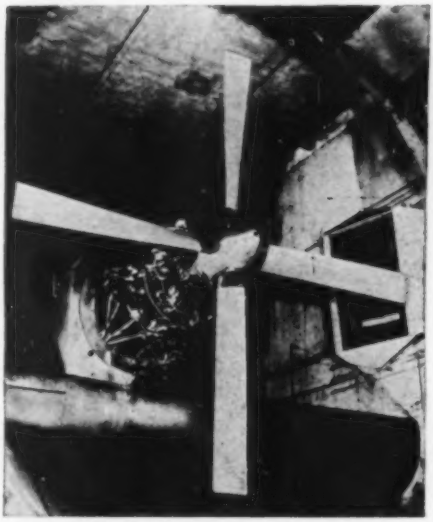
The burner is a Diesel-oil nozzle between two electrically ignited butane-gas jets. It can be adjusted for close range or to throw a flame 10 feet. The water jets use 1.7 to 8 gallons a minute to deliver a driving spray or a floating fog over a strip one to eight feet wide.



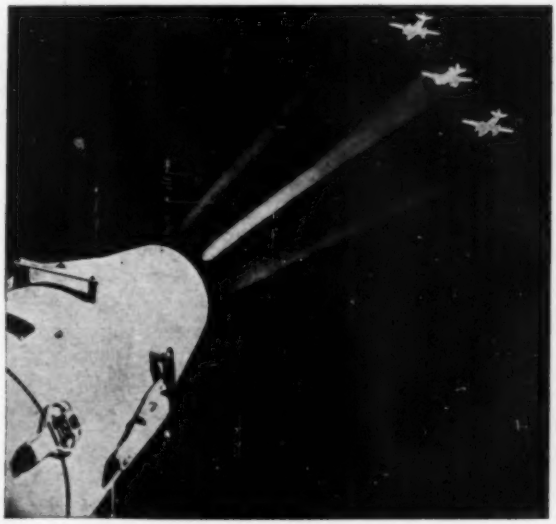
One man, using this tractor with its 30-ft. steel boom, can nose over 200 to 300 dead trees a day—a week's work for two men with a power saw. Trunks are then removed, cutting fire hazard. Heavy angle-iron support for boom protects the operator from falling branches.

What's New in Aviation

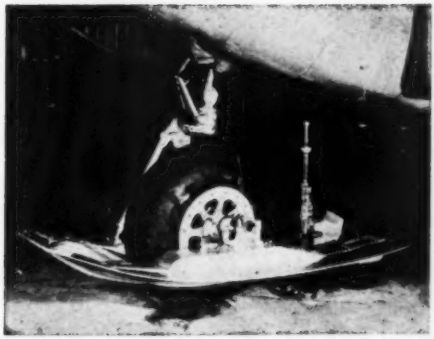
New British Jet Trainer. The Gloster Meteor VII, shown above, is designed to bridge the gap for student pilots between piston-engined advanced trainers and jet fighters. A modification of the British Meteor fighter, it has two seats and dual controls, and is powered by two Rolls-Royce Derwent jet engines. Top speed is 585 m.p.h.; rate of climb, 8,000 feet a minute. The plane's U. S. counterpart is the trainer version of the Shooting Star jet, the TF-80C (PS, June '48, p. 86.)



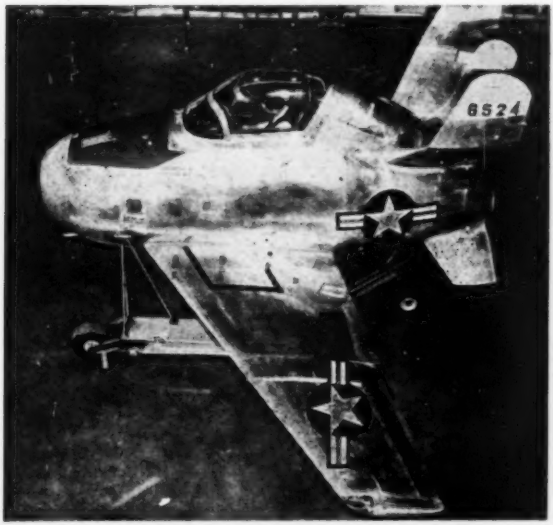
Prop Is Longer, Lighter. Sixteen and a half feet in diameter, this new Hamilton Standard propeller saves 200 lb. in weight. The secret is in its four hollow steel blades. To increase sectional rigidity they are filled with hard sponge rubber. Wide tips boost power by increasing the surface area of the blades where they move fastest. Shown in the photo mounted on a 3,500-hp. Wasp Major engine in a test cell, the new propeller is to be installed on many of the new Boeing Stratocruisers.



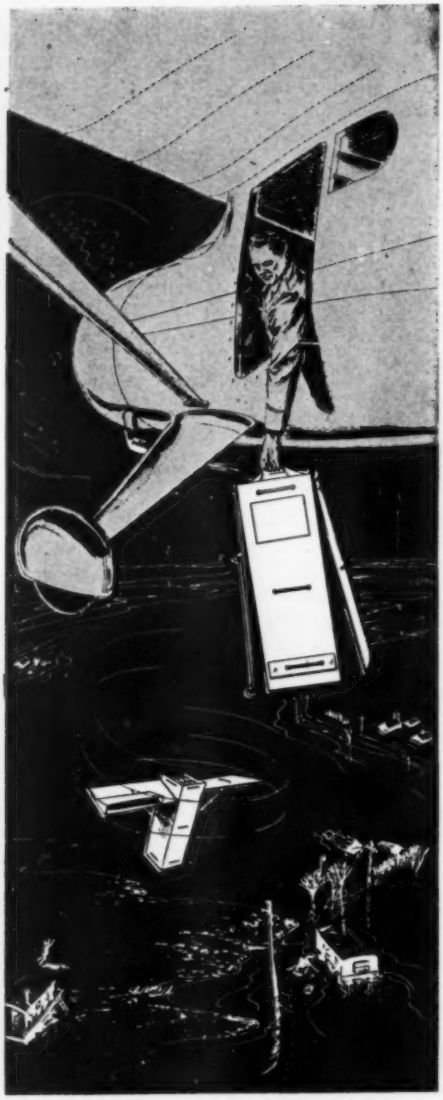
Visible Beams Direct Landings. Pilots really get a green light with a new Westinghouse device that guides them into an airport at the correct approach angle. As shown with model planes above, a projector throws three colored pathways into the sky. The pilot of the top plane, coming in too high, sees a yellow beam; to the lower plane, too low, the light is red. Only the center plane gets the green light. The projector uses a single 100-watt lamp, is expected to aid training and airport operation.



Landing Skis Retract. With these new skis on its landing wheels, a plane can sit down on snow or concrete. In flight, the skis can be retracted or lowered electrically. They've been tested successfully on a Fairchild C-82 cargo plane (photo shows device on nose wheel) by the Air Materiel Command at Wright Field, Dayton, Ohio.



Fighter Rides in Bomb Bay. This stubby jet plane turns big bombers into flying aircraft carriers. Called the McDonnell XP-85, it is a parasite fighter designed to be launched in mid-air from B-36 bombers. Wings, extended in flight, are folded to fit in bomb bay. Shown on a dolly, the XP-85 has no landing gear—it is to be picked up by mother plane. It's 15 ft. long, has a wing span of 21 ft., and is powered by a Westinghouse J-34 engine with a 3,000-lb. thrust. Tests are being made in a modified B-29.



Carton Sprouts Wings. A new package for delivering sanitation chemicals to flood-isolated communities can be dropped from a plane, as shown above, without a parachute. Upon its release, wings open out from each side. These give it a spinning motion that slows its descent. Developed by the Mathieson Alkali Works, the winged container holds six 5-lb. cans of calcium hypochlorite—enough to purify up to 2,500,000 gallons of drinking water, depending on the degree of contamination.

Records Any Language

THE Palantype ® operator above can take her boss's dictation at up to 200 words a minute in any major language—and she needn't even understand the language. Similar to present stenographic machines but more versatile, the British-made device uses a phonetic system in which words are recorded by their sound instead of spelling.

"Spider" Spins Power

THIS 35-ton "spider" will soon be spinning out more than three million watts to help increase the electric power of the Denison Dam on the Red River near Denison, Tex. The Westinghouse giant is the central skeleton of a 250-ton rotor for a new water-wheel generator. The ends of the spider's 10 arms will whirl around at 72 m.p.h.

Magnifies Microfilm

MICROFILMED print as small as 36/10,000 inch high can be read easily with this projection viewer that enlarges the letters 14, 20, or 35 times their original size. Made by the American Optical Co., it has a reflectionless viewing screen and a brightness control. The device can also make photographic copies in two minutes without a darkroom.

Machine Shines Shoes

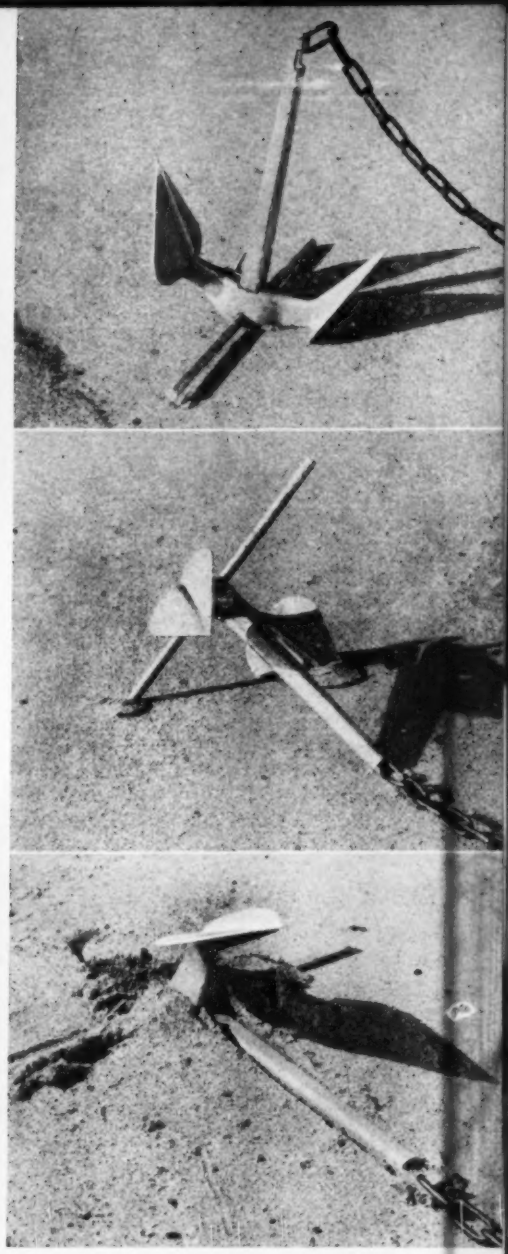
A ONE-MINUTE shine for both shoes is provided by these coin-operated machines made by the Kinmont Manufacturing Co., of Los Angeles. Moving buffers impregnated with wax take one shoe at a time and shine and polish it simultaneously. At the end of 30 seconds, a light flashes, indicating it is time to change to the other foot.

Sparks Measure Voltage

THESE two balls, with a spark jumping between them, are the main elements of a new laboratory yardstick to measure electrical voltage. The higher the voltage—90,000 in this photo—the farther the spark will jump. Westinghouse engineers use the yardstick to test insulating material for radio, television, and power-line equipment.

Mass-ProducedTurbines

HERE's one of a new line of GE steam turbines that are only 1/50 to 1/6,000 the size of their well-known big brothers in ships and powerhouses. Working parts of models from 10 to 1,200 hp. are standardized for mass production. They can drive pumps, compressors, fans, auxiliary power plants, and oil-field and refinery equipment.

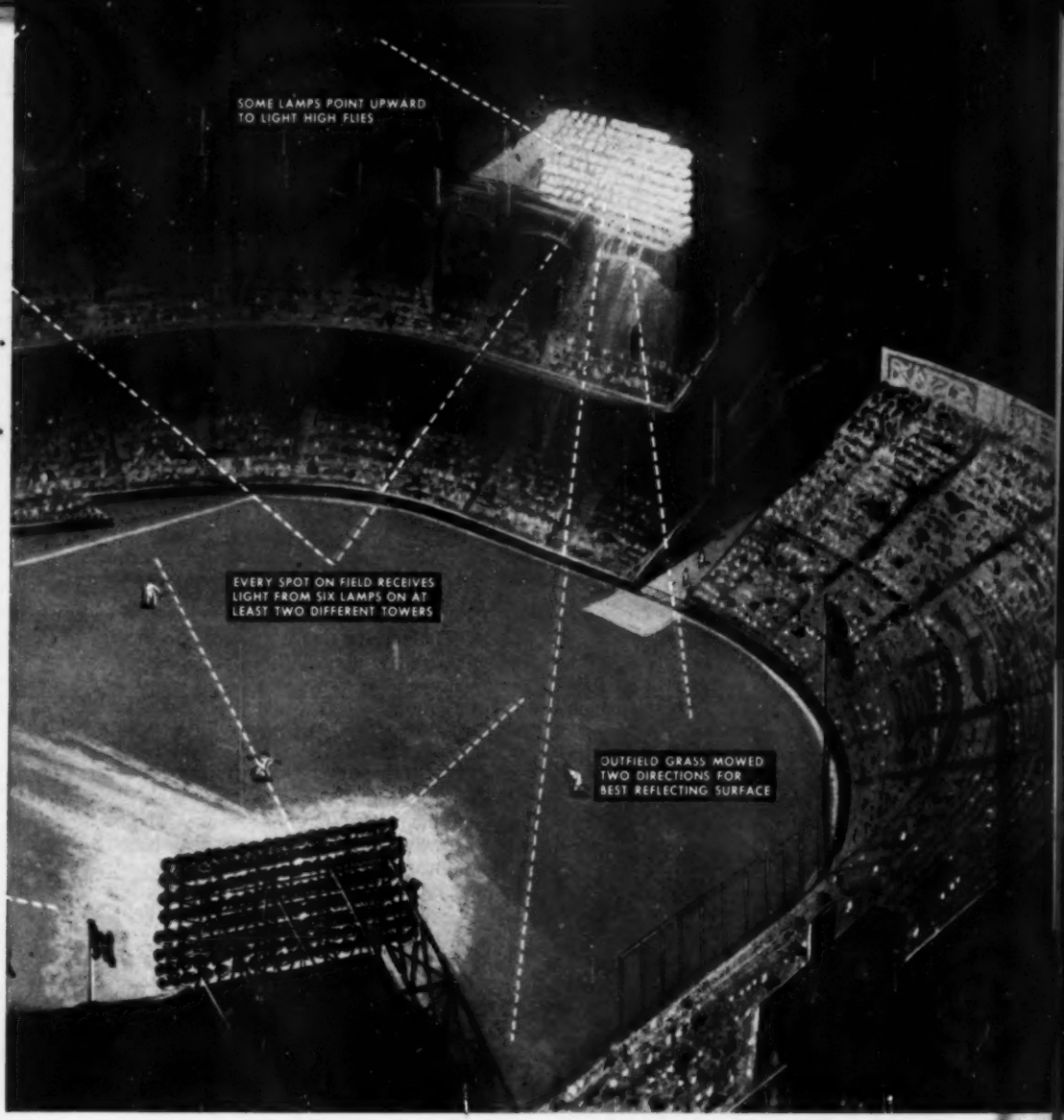


Anchor Buries Itself

THIS small-boat anchor depends on its shape instead of its weight. As shown above, when it hits bottom, drag turns it so that one of two plow-shaped flukes starts digging in. Within five feet, it's firmly buried. Its maker, the Northill Co., of Los Angeles, says 3-lb. model shown here will hold a 12-ft. boat in a strong wind or current.

Behind the Lights At a Night Ball Game

More than a thousand lamps, each aimed before it's turned on, bathe the field in daytime brilliance without glare or shadows.



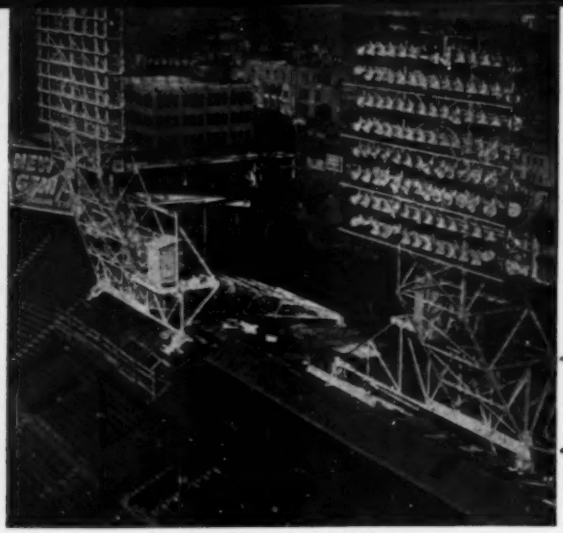
By George H. Waltz, Jr.

WHEN you go out to root for your favorite ball club in its night games this summer, there's little chance that you'll suffer the fate of the fans who braved the first after-dark baseball game ever played. That was on the night of June 2, 1883, and it was the first attempt at any kind of outdoor sports lighting. It was a nice breezy summer evening—and both spectators and players spent most of the game in the dark. The wind kept blowing out the handful of open-face arc lamps strung around the field.

Sports lighting, thanks to the foresight of a small band of pioneers and to the public's enthusiastic response to night games, has come a long way since then.

Today, in major-league ball parks like New York's Yankee Stadium and Boston's Fenway Park, the playing field is bathed in just about ten times as much light as you get from the lamps in your living room. In the terms of the lighting engineer, that's 200

Baseball-park lighting project starts on the drafting board of an engineer who figures out how to aim each of more than a thousand floodlights, like one in foreground, for best results.



Lights are supported by seven or eight towers high above the playing field. These going up on Briggs Stadium, home of the Detroit Tigers, are part of the newest big-league installation.

foot-candles of illumination on every grain of dust and every blade of grass. The top of your living-room table probably doesn't get much more than 20 foot-candles. What's more, the baseball—no matter where, on or above the playing field, its trajectory may carry it—is always scientifically lighted to the best advantage of the player who is fielding it.

Lights Aimed on Paper

But rigging a ball park for night games is no simple business of putting up enough lights of enough power. Each floodlight—and the average big-league field requires more than a thousand—must be carefully placed and aimed to add its illumination to the general lighting pattern. The job begins on an engineer's drafting table and doesn't end until the switches are thrown on the first try-out night.

Late this spring 1,386 floodlights of 1,500 watts apiece—using enough power to light a city of 10,000 people—glowed for the first time over Briggs Stadium, home field of the Detroit Tigers. More than a year ago that $500,000 lighting project, like many another major- and minor-league ball-park lighting installation, began on the desk of John E. Brock, one of General Electric's sports-lighting experts. With slide rule, protractor, stadium blueprints—and a good deal of past experience—he calculated just where each of the 1,386 individual floodlamps should be placed and aimed to provide shadowless illumination for players as well as spectators.

His problem can be compared with trying to cover a green table with cardboard ovals by placing them so that none of the green can show through. His answer was a series of aiming charts, one for each of the stadium's eight lighting towers. These charts gave the aiming angle for each lamp—the number of degrees it should be turned to right or left, up or down. Workmen, by setting calibrated dials on the floodlight mounting, could then adjust it precisely to the lighting engineer's carefully calculated specifications.

This method allows the lights to be aimed in the daytime. In most cases, the engineer's initial calculations are so accurate that it isn't necessary to re-aim a single lamp when the floodlights are turned on after dark.

Pre-aimed lights were first used in Yankee Stadium in 1946. They have since been installed in Fenway Park and Cincinnati's Crosley Field, as well as in Briggs Stadium, and are being used in practically all General Electric's new and revamped installations throughout organized baseball. The lamps, made of specially processed aluminum, weigh only 18½ lb. apiece. Their cover glass can withstand the hardest line drive; fast-ball pitchers have tried—and failed—to break it at a range of ten feet.

Conduits shield cables that carry current to the individual lamps. The Briggs Stadium lights use, all together, 2,416,000 watts of power—enough to light a city of 10,000 people.

When closed, the floodlight unit is sealed tight against rain, soot, and insects; yet the lamp can be replaced simply by unlocking and removing the socket, without disturbing the aim setting.

What to Watch For

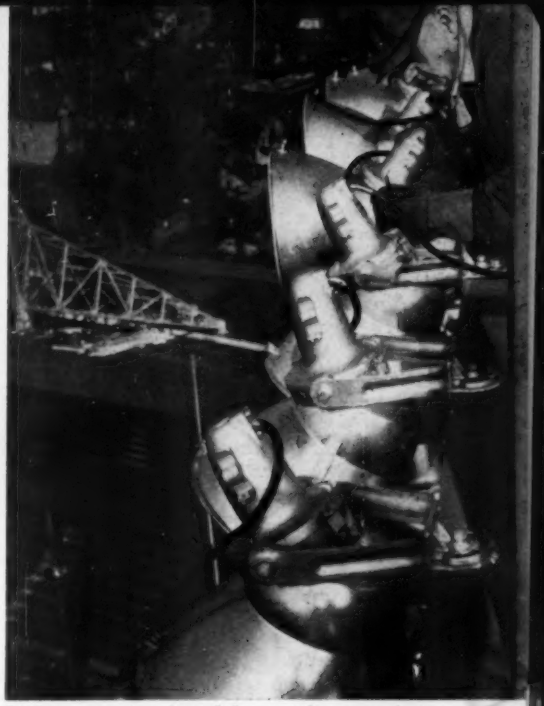
Next time you go to a night ball game, take a good look at the lighted surface of the playing field, watch the ball closely in its flight, and notice the location of the tall towers that support the floodlights:

Any one spot that you may pick out on the field is receiving its light from six different floodlights on at least two different towers. That eliminates shadows.

No matter where the ball is, it's always lighted on the side toward the player who has to field it. That's why some of those lights point up instead of down; if all pointed down, a high pop fly might get out of the field of illumination.

Not one of the towers is in a direct line with any of the principal lines of play—the baselines, the line from first to third, and from second to home. That eliminates the possibility of blinding a player with too much light from one source.

Finally, when the game is over and you can walk out on the field, examine the grass in the outfield: It has been mowed in a special way to provide the best possible reflecting surface for the overhead lights. This trick was discovered back in 1930,



Lights are aimed to left or right as each is attached to steel girder by a single bolt. Up-or-down aiming follows. Both adjustments are made in daytime before the lights are turned on.

Calibrated dials on the mounting make aiming easy. Installer simply adjusts lamp vertically and horizontally to dial settings given on aiming chart, then locks the mounting in that position.

when the third modern baseball lighting installation was completed at Perry Stadium in Indianapolis. On opening night, what appeared to be a huge shadow covered deep right field. After the game, the lighting engineers discovered the cause: since the grass had been mowed in one direction only, most of the blades had been bent into a position in which they offered a poor reflecting surface to most of the light hitting that part of the field. Now ball-park grass is mowed in two directions along concentric arcs fanning out from home plate.

Outdoor lighting, and the popularity of night baseball, came to us via railroad. In the early 1920s railroad officials decided to floodlight their yards to permit 'round-the-clock operations. This work gave Robert J. Swackhamer, a General Electric lighting man, a chance to test high-level lighting. In 1927 he convinced his bosses that it could be applied to sports lighting, and they let him rig the company baseball diamond at Lynn, Mass., for a night game. Seventy-two floodlamps lighted a game between Lynn and Salem on the night of June 24, 1927.

Pro Teams Adopt Lights

The first professional night game was played at Des Moines, Ia., on May 2, 1930. Two seasons later Larry MacPhail, then general manager of the Columbus Red Birds in the American Association, installed high-level lighting in their stadium. In 1935, as general manager of the Cincinnati Reds, he introduced night baseball to the major leagues. Later, as president of the Brooklyn Dodgers and then of the New York Yankees, he put lights in Ebbets Field and Yankee Stadium. Now only one major-league team, the Chicago Cubs, is without lights in its home park.

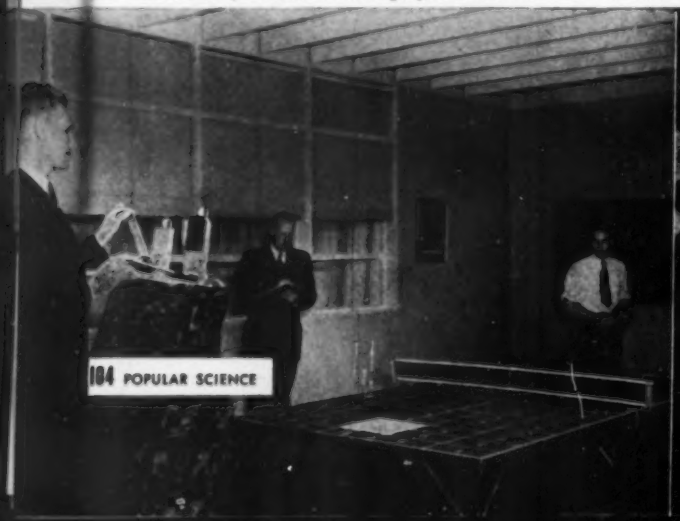
In 1935 MacPhail's Reds played seven league games under lights at Crosley Field. This year Cincinnati alone will play 36 night games; all major-league teams together will play a total of 357—163 in the National League, 194 in the American. Almost all minor-league games this season are being played under floodlights.

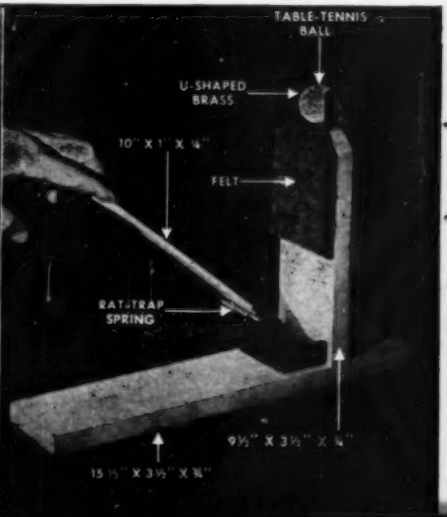
Lighting Other Sports

And sports lighting, by turning night into day so that Americans can take their fun when they have the most free time, has spread far beyond the baseball parks. Lights now are being used for almost every outdoor sport from archery to volley ball. Softball, thanks to floodlights, is running a close second to bowling in number of participants. The police of Milwaukee say lighting its tennis courts and public playgrounds has cut petty crime, vandalism, juvenile delinquency—even night traffic accidents.

Lighting engineers are also working on better illumination for indoor sports. The pictures below show a laboratory and apparatus used at General Electric's Nela Park in Cleveland to find out how much light you need for table tennis. The answer —20 foot-candles for normal rumpus-room games, 50 for fast tournament play—may interest you less than the researchers' discovery that practice in returning smash serves from the easy-to-make ball projector improved their games. END

Best lighting for table tennis was determined by experiments of General Electric engineers in which they scored skilled players on their ability to return smash shots from a spring-powered ball projector (right, below) that shoots balls across net at speed of 40 m.p.h.





Cage Tests Grates

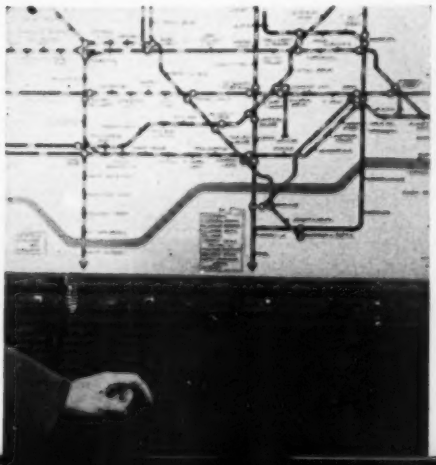
THIS screen can stand in front of a fire and tell you how much heat it throws out. Thermocouples on the frame register the answer on meters in background. Fuel-conscious Britons developed the tester to help get the most heat from the least coal.

Movie Camera Dances

A LIGHT camera carriage, strapped to the male partner of a movie dance team, now keeps the actors in focus as they glide about a ballroom floor. Device was first used to film Ava Gardner and Robert Walker (above) in "One Touch of Venus."

Subway Guide Lights Up

A NEW pathfinder for subway travelers, shown below, operates on the principle that the quickest route is—literally—the line of least resistance. The resistance is that in strings of neon lights along alternate routes between any two stations on the map. When buttons are pushed for starting point and destination, an electric current selects the connecting circuit with fewest neons, and thus lights up the quickest route. The system, developed by Sperry, Ltd., was tested in London's subway.



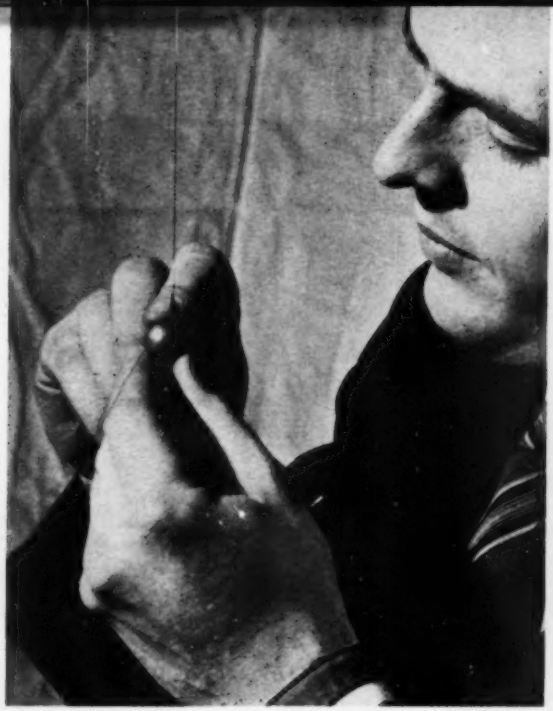
Garden Grows on a Wall

HERE's how a California gardener (below) turned his strawberry patch on its side. Henry Hayward, of San Fernando, set 350 plants into the hollow sections of cement blocks that form two parallel walls 13½ feet long, 6 feet high, and 6 inches apart. The roots grow in fertilized soil that fills the space between the walls, and are watered from the top by a pipe with holes drilled through its under side. The patch needs little other care, Hayward says—and no weeding at all.

MARCH OF SCIENCE

Predicts Position of Moon. Want to know where the moon will be at midnight on July 4, 2148? That's child's play for the world's smartest "electrical brain." This 12,500-tube super-calculator, built by International Business Machines, is compiling tables that tell the moon's position at any date and hour. Computing a single position, a day's work for a mathematical wizard, calls for 19,390 additions, subtractions, and multiplications of terms like "0.00001 10108 sin (0.53734 104–0.00001 01044 17 t + 0.00000 00000 00025 60 t^2)." The machine does it in seven minutes. In composite photo, left, moon pictures symbolize problem that girl at controls is feeding into "brain." Answers are punched on cards, which a card-operated electric typewriter translates into numbers.

Wet "Wind" Tunnel. If airplane designers could "see the spray" of their products speeding through the air, a famous builder once remarked, there would be many changes for the better. By using water instead of air to test models, Boeing engineers now make "seeing the spray" a reality. High-speed air flowing past objects is simulated by a slower-moving current of water, in a wet "wind" tunnel measuring four feet long, five inches high, and one-half inch wide. Microscopic particles of bentonite clay suspended in the water impart to it a special refractive power. When the test chamber is illuminated by polarized light and viewed through a suitable screen, flow lines and eddies leap into view as brilliant patterns of blue, green, yellow, and orange hues. Observations of this "spray" have already proved useful in designing burners for ram jets, and wider applications are foreseen. At left, below, experts study the turbulence set up by a cylinder, shown in close-up at lower right.



Artificial Raindrop. This plastic model of a raindrop effectively imitates a real one—and will hold still. It serves Westinghouse engineers as a target for ultra-short-wave radar in experiments to find out why rain upsets reception of signals.

Unspared Rod. Stretched at 1,000° F. by 6,000 lb. since a month before Pearl Harbor, this much-abused rod will next be strained until it breaks. The drastic tests tell GE engineers how molybdenum-vanadium steel will stand up in turbine parts.

Soil Preserved Intact. To take home loose soil for study, University of Wisconsin geologists have devised the technique shown from left to right below. They drive angle-iron frame into exposed bank, close it with plank, lay tray of soil flat, and apply Vinylite ® resin. When this liquid hardens, permanent specimens are obtained.

Long, sweeping strokes with mitten's palm cover large areas; thumb gets hard-to-reach spots.

Before. It took two days of cleaning, sanding, and patching to get the author's '39 Olds ready for the big moment. A dull, dark gray before, it had soon become a deep, rich, shiny maroon.

After. Here is the same car just four hours later. Shown with only first coat of paint, it had already taken on new life and luster. A second coat, plus polishing, completed the job.

I Painted My Car With a Mitten

By W. W. Morris
Chief Photographer, Popular Science Staff

PAINTING anything more than a screen door has been strictly a spectator sport for me. I felt about painting a car the way I felt about working with plate glass—it was all right for the experts, but not for me. I would stick to taking pictures of somebody else taking the risk.

A mitten, however, made me an expert. Without brush or spray gun, I painted my car successfully. The mitten that made this possible was part of a kit put out by the Arco Company, of Cleveland. Called Pad-O'-Paint ®, the kit contained everything from the paint and mitten applicator to sandpaper and patching filler—even cleaning cloths, putty knife, and a small paint brush. It was supposed to do as good a job as a regular paintshop. All I had to do was supply the car—and the muscle.

I decided to experiment first on something less fatal than the family car. I had an old, beat-up photo reflector, so I mitten-painted that. It looked good. I was encouraged. Then I sandpapered a spot on one of the fenders of my '39 Oldsmobile and proceeded to mitten-paint that.

Doubt dies hard. I kept plenty of benzine handy to wash the paint off if the spot didn't look right when I got through. In a couple of hours the paint was dry. The spot didn't look bad.

"Okay," I thought, "I'll give it a try."

First I had the job of cleaning the car. Here I departed from the printed instructions in the kit, which advised the use of dry sandpaper. In talking with the men in the POPULAR SCIENCE home workshop department, I learned that it would be easier to do the job with wet sandpaper. I did most of this under running water. In addition to the two grades of sandpaper that came with the kit, I used #120 (coarse), #360 (medium), and #500 (fine). This was necessary to get all the stains off the old finish and smooth it down for the new one. Where rust showed, I had to sand down to the metal. This took two days.

After that, I followed the directions exactly. Small dents and holes were leveled with the plastic filler supplied with the kit. I used a solvent cleaner to remove the eight years of accumulated wax and grime. This also came with the kit. So did a lint remover that I used just before painting.

"This had better work," I said to myself as I remembered the weekend just spent getting the car ready. Feeling like a paratrooper on his first jump, I made a bold swipe at the top, where the instructions

Everything but the muscle. Besides mitten applicator, Pad-O'-Paint ® kit included solvent cleaner, plastic filler, paint tray, cleaning cloths, sandpaper, putty knife, and a small paint brush.

After thorough washing, entire car was carefully sanded—down to metal where old paint was worn or rust had formed. Waterproof sandpaper was kept soaked under stream from hose.

Small dents, holes, and scratches were patched with the plastic filler, worked in and smoothed with a putty knife. These, too, had to be carefully sanded after the patching filler hardened.

Solvent cleaner dissolved old wax, grease, and imbedded grime. Just before paint was applied, car was given last-minute rubbing with a special cloth provided for removing dust and lint.

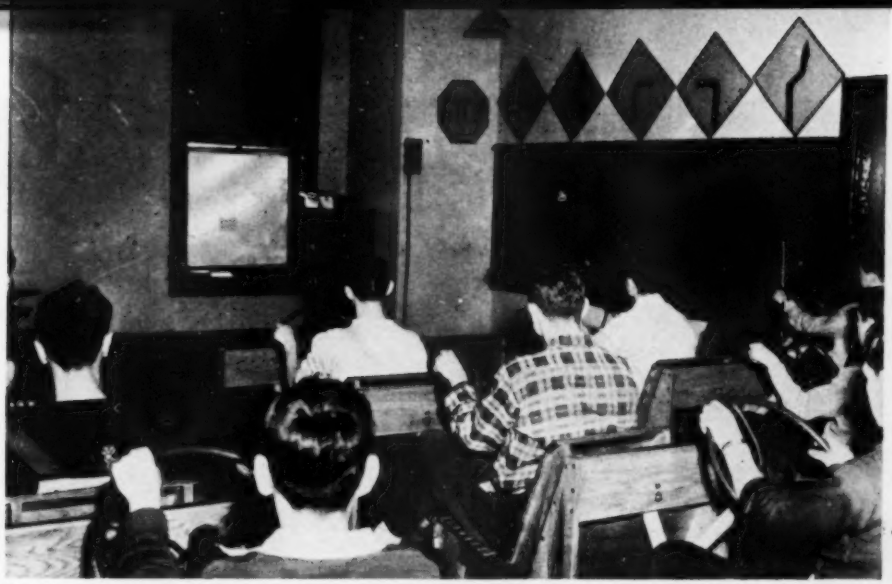
said to start and where, incidentally, I figured only the birds would notice if something went wrong.

But the paint went on nicely. Using long, even strokes with the palm of the mitt, I covered the large spaces quickly and, by maneuvering right, avoided streaks and overlaps. With the small dauber on the thumb, I was able to paint up close to the trim and get at the hidden, hard-to-reach places. And in even tighter squeezes, I used the kit's small paint brush. Another handy gimmick was the circular tray that fitted into the paint can. Resting on a coil spring, it made it easy to get the right amount of paint on the mitten at any level in the can.

Now I know I can paint a car. There was only one trouble, and that wasn't with the paint. Every now and then I had to stop to take some pictures. These were in color, and the car had to be placed in the sun for the proper light. That made the paint dry a little too fast, and I got a faintly streaked look here and there. But a second coat, for which the kit provided an ample supply, took care of that.

The whole paint job took about four hours. Add in the two days of sanding down, and I figure I got a paint job for less than $10, plus a busy weekend. This means I saved around $60 over neighborhood repaint prices, to say nothing of the $100 to $150 added to the car's trade-in value—pretty good pay for two or three days' work. END

Starting at the top, right half was done first, then left. Then came back, rear fenders, sides, hood, and front fenders. Paint was smeared on, then stroked smooth, was dry in 1½ to 2 hours.

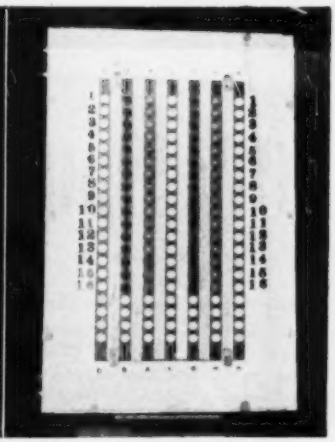


Students seated in driving units watch traffic light, left of stop sign, on classroom wall.

Motoring Taught Like Flying

HIGH-SCHOOL students built these working mockups of automobile driver's seats to practice driving without risking their necks. Sixteen of the units, complete with controls, are now being used at Bloomington, Ind., to teach driving the way aviation cadets learn flying in Link trainers. All the parts, except the steering wheels and rubber pedal pads, were made in the school's shop classes at a total cost of $500.

Two hundred and fifty students take a one-semester course in the trainers before going outside for practice in a dual-control car. The final exam is an imaginary tour of Bloomington, on which the teacher describes actual traffic situations and checks the speed and accuracy of the students' response as flashed on a control panel. END



Driving unit has usual hand and foot controls. Response with them to traffic situations registers in colored lights on panel at right. Numbers indicate the 16 units; letters, the controls: C for clutch, B for brake, A for accelerator, L for low gear, S for second, H for high, R for reverse. Panel, made from an old telephone switchboard, can accommodate four more units.

Test by fire compares resistance of Kaylo (T) door, left, and standard wooden door. This view is from exterior. Time elapsed after fire was lit is shown on this picture and the series at the right.

New Door Resists Fire

THIS door may some day stand between you and death. How it can be used to safeguard apartment dwellers and hotel guests against flames sweeping through corridors is strikingly shown in the test above.

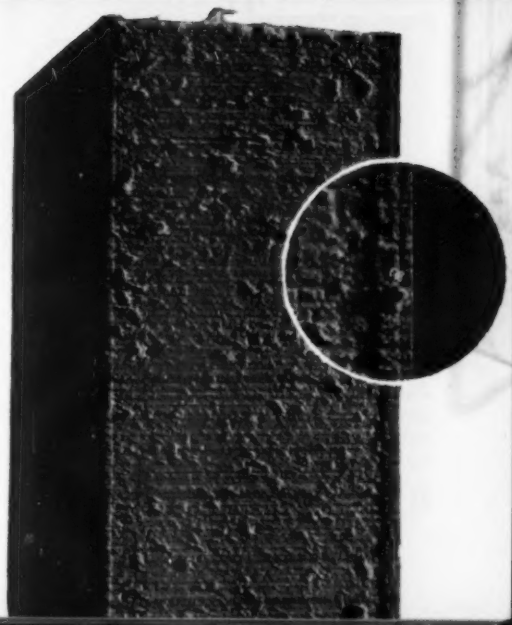
The new door, moderately priced, has been given a one-hour fire rating by the Underwriters' Laboratories. That means it has withstood 60 minutes' exposure to a temperature of 1,700° F., plus a one-minute battering from the stream of a fire hose. For a person trapped in a room of a burning building, the door will be a solid bulwark against flames and suffocating gases until firemen come to his rescue. Its inner side won't even get hot—just warm.

Outwardly the wood-veneered door resembles any other. Its secret lies in a grayish-white core of cellular, noncombustible material, made from lime, silica, and asbestos, which was first developed to serve as heat-insulating lagging for boilers and steam pipes. By a slight modification of the original manufacturing process, the Amer-

Results: Interior views, top row, and later exterior scenes show how flames eat through wooden door while Kaylo ⓣ door bars fire. Outer veneer chars, but the core and inner side remain intact.

ican Structural Products Company of South River, N. J., now produces a higher-density insulation especially suited for use in fire-resistant doors and partitions. Because its heat conductivity (which engineers designate by the symbol "K") is low, it has been named Kaylo ⓣ. It can be sawed, drilled, and nailed with ordinary tools.

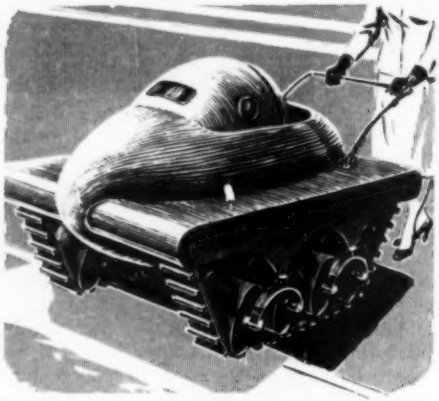
A flush-type door using this material will be manufactured and marketed by the U. S. Plywood Corporation as the Weldwood ⓣ fireproof door. Its cross section is shown, actual size, in the photo at right. A thin, two-layer finish of plywood veneer, seen in the magnified inset, is not intended to survive a scorching. Both the structural strength and fire resistance are in the Kaylo ⓣ insulation that makes up the rest of the thickness of the door. END



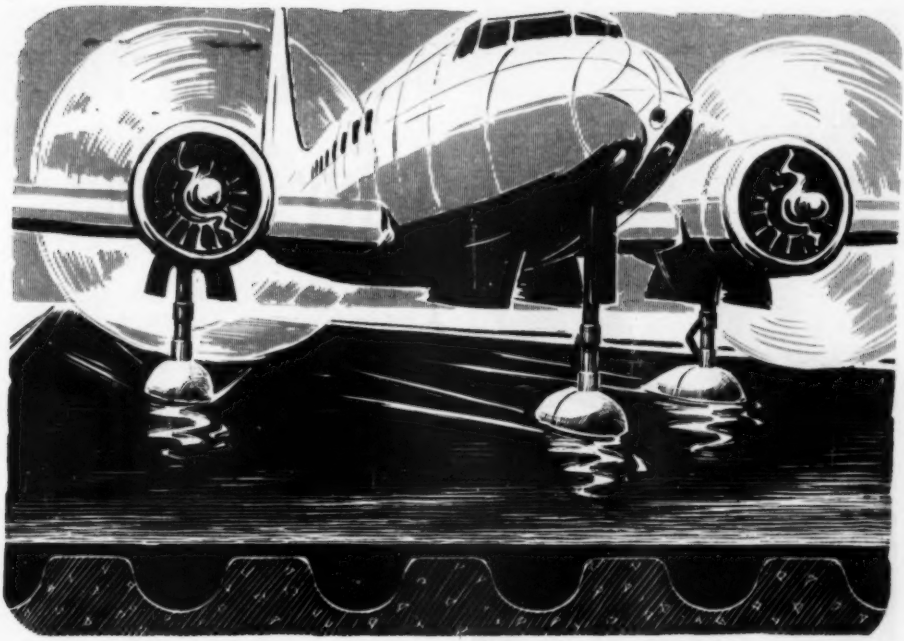
New Ideas from the Inventors

Seats Save Train Space. Both diners and waiters aboard railroad dining cars would get a break with the seating arrangement patented by Francis Dittrich, of Chicago. Angled four-tables along one wall permit waiters to serve from either side instead of having to reach across diners next to the aisle. For greater aisle space, tables along the opposite wall are three-sided, seating two. The seats by the windows are built-in.

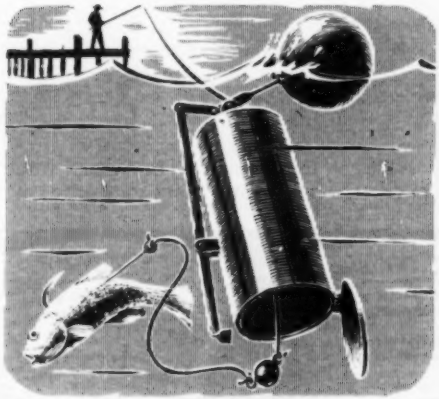
Water Joins Fire Hose. Water holds this flexible fire-hose coupling together, and the higher the pressure, the tighter the joint. Its two rubber ends are simply squeezed together, and a ridge on one locks into a groove in the other. It was invented by Pierre Delcourt, of Vertus, France.



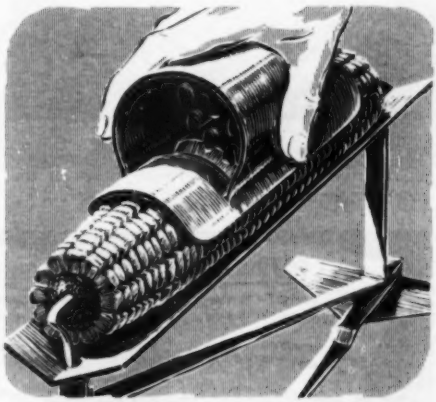
Mechanized Baby Carriage. Tracks replace wheels on this novel baby carriage, providing smoother going over curbstones and doorsteps. Patented by Anthony Peronti, of Chicago, it also has an airplane-type canopy to protect Baby from sun glare and rain, and a brake lever on handle.



Slide, Airplane, Slide. Landing on this airfield would be like sliding in on a giant washboard. Long grooves, shown in profile above, are flooded with soapy water. The bullet-shaped cylinders, replacing plane's wheels, slip into these grooves and slide along on the soapy water. Its inventor, H. V. Ramirez, of Los Angeles, claims it would guide planes in straight line, save weight and cost of usual landing gear.

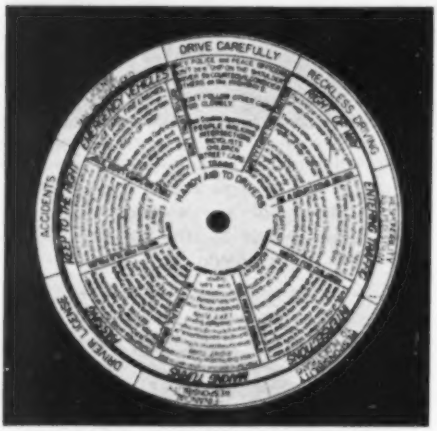


Container Protects Bait. A longer life for live bait is the object of this casting container invented by Anders Mason, of Springfield, Mass. When it strikes the water, a cork float on top is forced upward, opening a small trap door in the bottom and releasing the bait, undamaged by the cast.



Corn Cutter Cuts Scatter. To keep corn kernels from flying in all directions when sliced off the cob, Arthur Skolrud, of Seattle, has patented a cutter that collects them neatly in a small cup just behind the blade. After each stroke, the cob is rotated on a pronged stand to a new position.

Inventor Clothier displays both sides of his Handy Aid to Drivers Ⓣ. Its three pie-sliced cardboard disks, turning on a common hub, offer quick advice on 30 motoring problems.



Front side of the wheel carries tips for safe driving and warnings of the risks of carelessness. Safety slogans are lettered between the seven segments of the smaller outer disk.

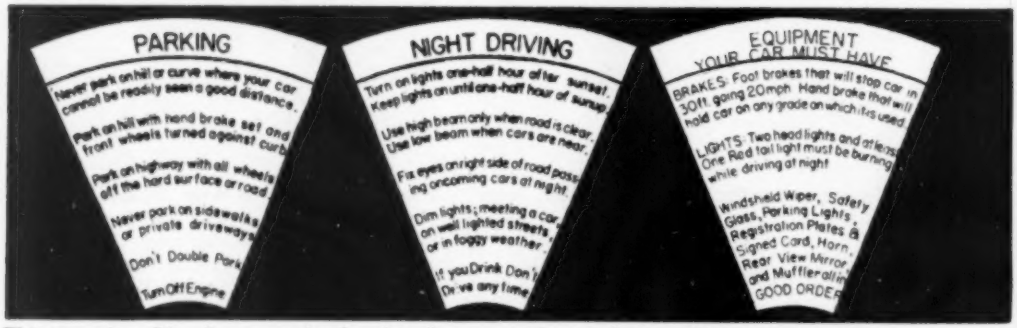
5th Wheel for Safer Driving

IF COLLECTING traffic tickets is your hobby, you won't be interested in this little cardboard wheel. Drivers who prefer to keep out of trouble may find it as handy as skid chains.

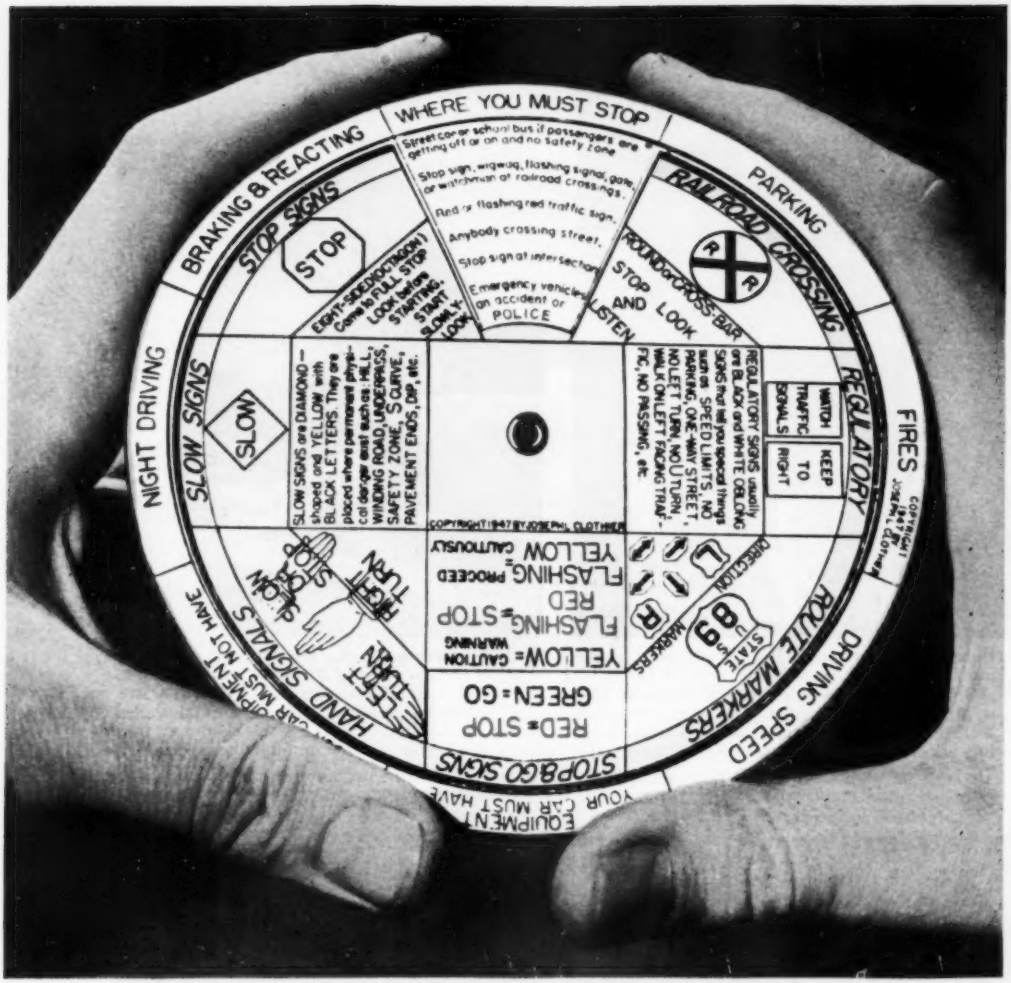
Only five inches across and no thicker than three postcards, it contains the gist of all U. S. motor-traffic regulations—boiled down to 1,371 words, classified under 30 headings, and arranged for quick reference. The pictures show how it works.

The Handy Aid to Drivers Ⓣ is the baby of Joseph L. Clothier, 37-year-old airport-control-tower operator at Tucson, Ariz. Designing the wheel, lettering it by hand, and getting it printed in four colors were the least of his work. Before that came 11 months of analyzing traffic codes of 48 states and dozens of cities.

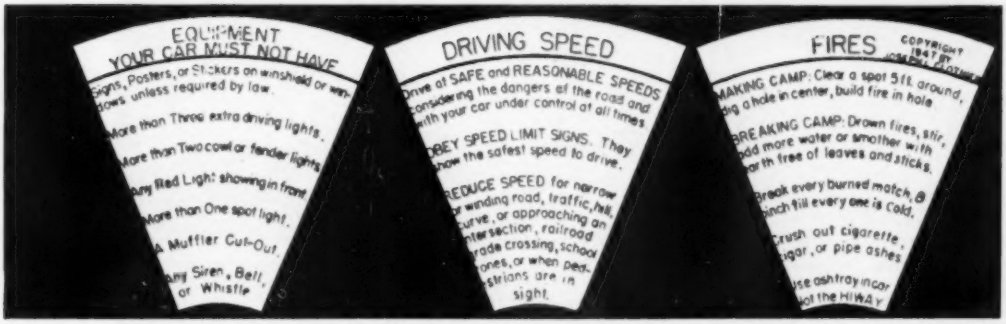
The result is not a summary of each code, but a capsule guide based on the fundamentals of all codes. In Arizona, for example, an accident that causes damage of $50 or more must be reported within 48 hours; in California, damage over $25 in 24 hours; in Louisiana, damage of $35 in 36 hours. The Handy Aid simply advises: "If death, injury or property damage occurs, regardless of the amount, report as soon as possible to the police." The driver who does that is clear in any man's state or town.



Thirty sections like these contain the gist of motor-traffic regulations all over the country.



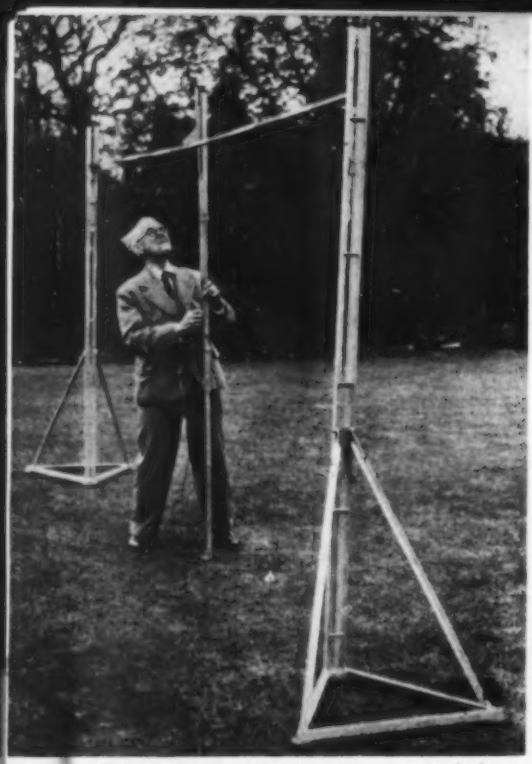
Reverse side is shown actual size. Smaller outer disk has one wedge cut away, so it can be turned for reading the tips under any of the headings lettered around rim of inner disk.



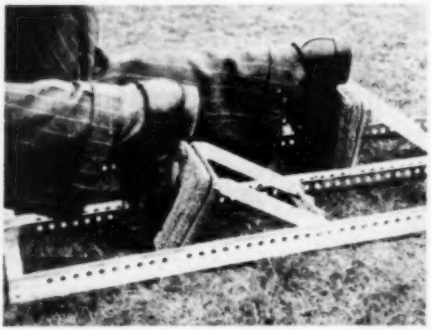
The wheel's capsule rules, if followed, will keep you out of most kinds of motoring trouble.

New Entries In the Olympics

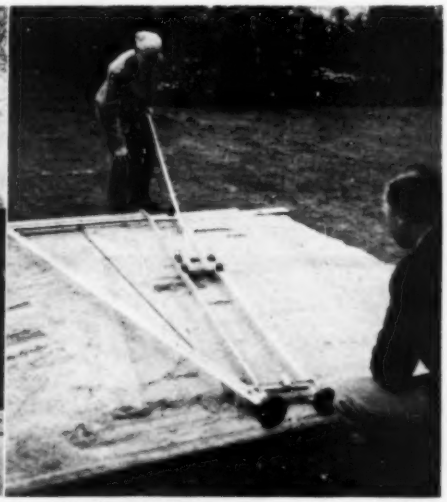
THESE odd-looking gadgets are designed to save time and arguments at the summer Olympic Games, which open late this month in London. A British engineer, H. Rottenburg, developed them as aids to judges and athletes in track and field events. Here he is demonstrating the light, aluminum apparatus at Cambridge, England.



Pole to measure high jump consists of aluminum tube and shorter rod that slides easily along it. When cleat on rod is lowered until it just touches crossbar, rod and tube are locked in relative position and then taken down for accurate measurement with a steel tape.



Mobile starting blocks for sprinters and hurdlers eliminate digging toeholds into the track. They adjust quickly to any stance and then are held firmly in position by pins through holes in the frame. Pads provide a thick, spongy mat for a good grip on the running-shoe spikes.



Broad jump is measured by lowering this frame over sand pit and rolling it along jumper's line of flight to point where cross wire is directly over his heel imprint nearest take-off mark. Length of jump then can be read on scale fixed to far rail. Afterward, the sand is smoothed (right) by blade on push-pull cart that rolls across the pit on the frame's own parallel rails.

The small Plexiglas ® fuel tank shown above represents one of the five tanks that are a part of the B-50's fuel system. For demonstration purposes, colored liquid, instead of gasoline, is pumped in. The training units are mounted on plywood panels 5 by 4¾ feet in size.

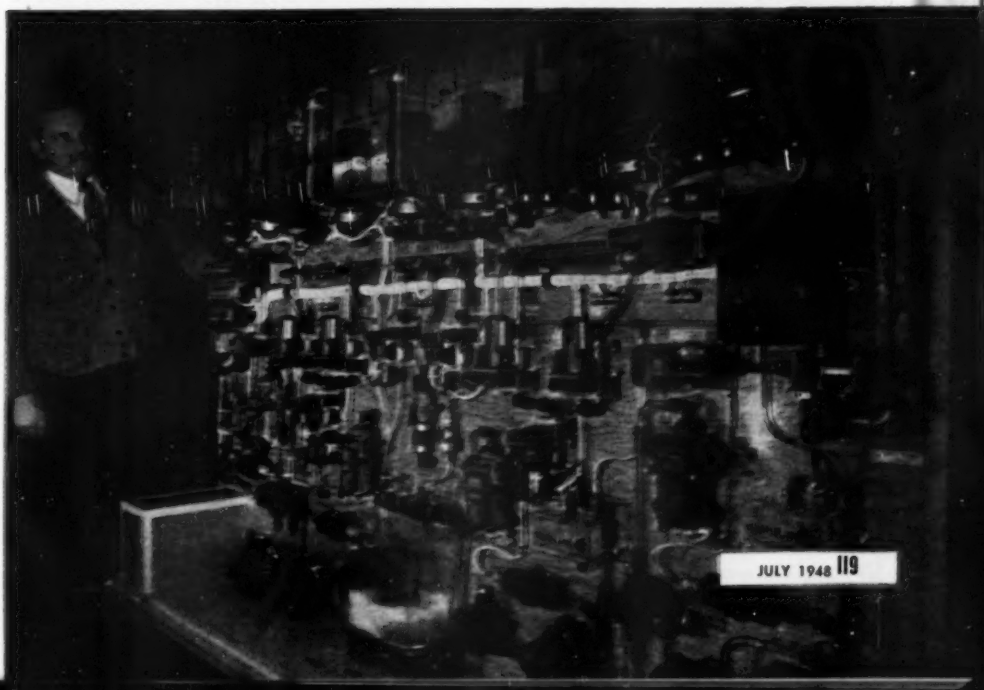
Fuel for the Tanks of the B-50

NOW being delivered to the Air Force, Boeing's B-50 is more than an improved B-29—it's a new and more powerful weapon for long-range bombardment.

The four 3,500-hp. Pratt & Whitney Wasp Major ® engines drink a lot of gasoline. To get maximum miles out of them, the fuel system must run at top efficiency.

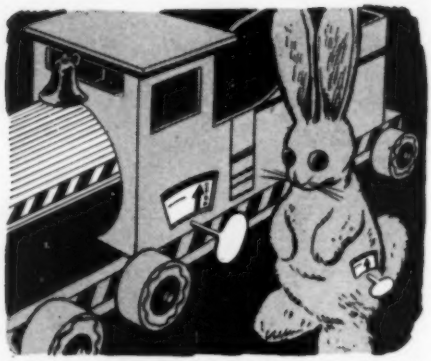
Jumping the gun, Boeing engineers have built training units that will explain the intricacies of fuel flow to crews before they receive the huge new bombers. Other panels include a landing-gear and wing-flap unit that shows operation of the B-50's ball-bearing retractor strut, nacelle-door actuator, and wing-flap mechanism. END

The intricate arrangement of tanks, lines, and valves pictured below demonstrates how the fuel system of the B-50 functions. Each part in this training unit operates exactly as does its counterpart in the big bomber, differing only in position and, in some cases, in size.



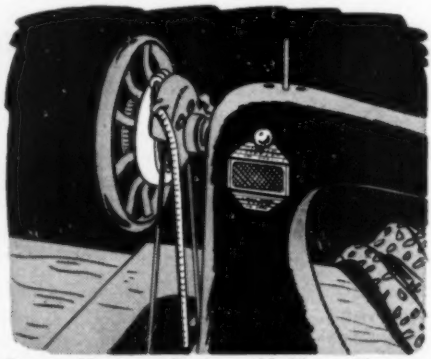
I'd like to see them make . . .

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.



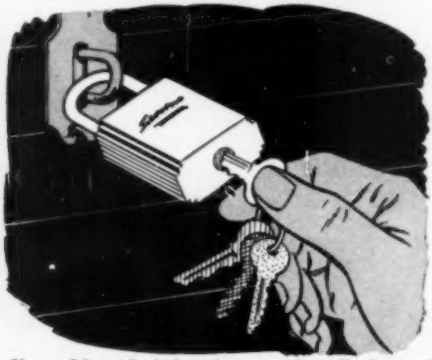
Childproof Wind-Ups. The mortality of wind-up toys through overwinding by children would be lower if the toys came with indicators on them to tell the user when they were sufficiently wound.—*Girard Strohl, Allentown, Pa.*

Right-Side-Up Matches. Matchboxes with a striking surface on the top, not on the sides, would prevent you from opening the box upside down in the dark and spilling the matches.—*B. C. Bamman, Macon, Mo.*

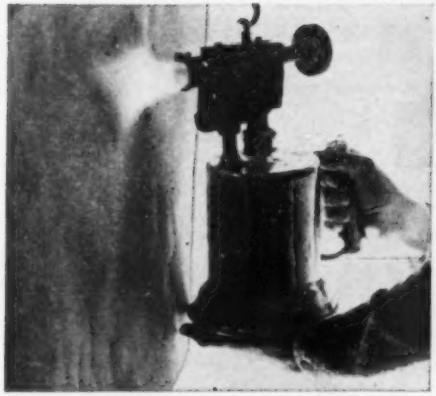


Sewing-Machine Brake. I'd like to have a brake on a sewing machine that could be operated by foot or knee. It would save having to grab the wheel at ends and turns of seams.—*Margie Spolar, Tigerton, Wis.*

Hot-Water Indicator. We're always running out of hot water when washing or bathing. Why don't they put an indicator over the sink that tells at a glance how much is left in the tank?—*Kenneth Fiske, Crannell, Calif.*



Keys Identified by Color. If padlocks and door locks came in different colors with keys to match, they'd take the fidget and fumble out of finding the right key for the right lock.—*J. A. Slais, Berwyn, Ill.*



New Paper Won't Burn

EVEN the flame of a blowtorch won't burn through this new paper, as the test above proves. Called Terratex ®, it's made of asbestos mixed with clay and pressed into sheets as thin as paper. General Electric, which developed the paper as insulation for high-temperature electrical equipment, predicts many other uses for it.

Human Power Line

THE lamp held by this Westinghouse scientist is lighted by current from the rod in his other hand. He is showing that high-frequency electricity skims across the surface of a conductor – his body – without penetrating more than a fraction of an inch. This "skin effect" is used to harden just the surface of metal by induction heating.

Lab Perches on Tower

SCIENTISTS of the International Telephone and Telegraph Corp. work in no ivory tower, but in one of steel sheathed with aluminum. The 300-foot structure, pictured above, is the latest addition to I. T. & T.'s Federal Telecommunications Laboratories at Nutley, N. J. Designed for research in the high-frequency radio waves used by radar and television, it has workrooms on three enclosed landings near the top, antennas on the roof, and platforms below the main floors for other equipment.

Super-Microscopes

Full power of projected proton microscope would magnify the molecule pictured below to the size of this circle.

Pea-sized white sphere in this remarkable electron micrograph is believed to be a single molecule of polystyrene latex. Magnification of 110,000 diameters is more than half the extreme power of today's microscopes.

Artist's drawing illustrates design of proposed proton microscope, with top magnifying power of 600,000 diameters or more.

A design harnessing a 300,000-volt beam of protons heads current projects for instruments of unprecedented power.

to Open New World

By Alden P. Armagnac

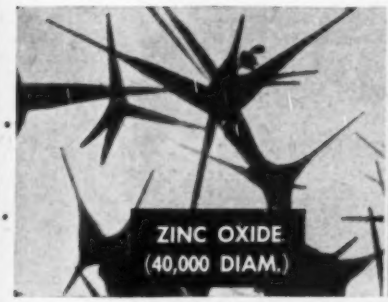
A NEW type of microscope is being designed at the College of France, in Paris. It is to be built around a 300,000-volt tube of a type hitherto used only in atom-smashing experiments. And its inventor, Claude Magnan, expects this "proton microscope" to give three to four times the magnification of today's finest in instruments.

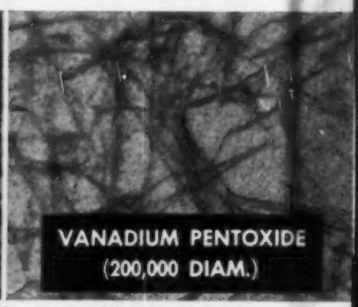
The new 16-foot-high microscope will look like an enlarged counterpart of the electron microscope, the most powerful of existing types. In place of a beam of electrons, however, the giant 'scope will use a stream of hydrogen ions, or protons, delivered by a new "proton gun" that Magnan has devised. The effect, similar to reducing the wave length of light used in an optical microscope, will be to multiply the magnification attainable.

Two electrostatic lenses will focus the proton beam—the first giving a magnification of 200 diameters, and the second increasing this magnification to 20,000 diameters. Images registered on film will be sharp enough to be further enlarged at least 30 times, giving a final magnification of 600,000 diameters or more.

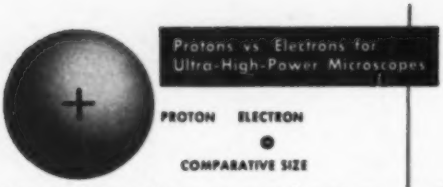
Making clear its limitations as well as its advantages, Magnan points out that the proton microscope will remain a special-purpose tool. Because protons lack the penetrating power of electrons, its application will be restricted to specimens of such extreme thinness as to be "transparent" to protons, or to objects of which only the surface is to be explored. It will not, therefore, outmode the more versatile electron microscope, or steal the spotlight from experimenters working to improve this type.

Today the most powerful instrument in the world is the experimental electron microscope of the RCA Laboratories at Princeton, N. J. Dr. James Hillier has recently boosted its useful magnification with an improved magnetic lens. A new telescopic eyepiece enables him to view its fluorescent-screen images directly at top magnification, formerly attainable only by making photographic enlargements from film records. Now he can either see or take pictures of an object magnified to the almost inconceivable figure of 200,000 times its original

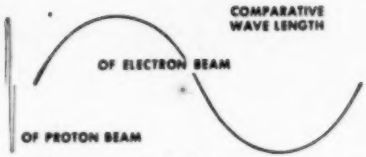




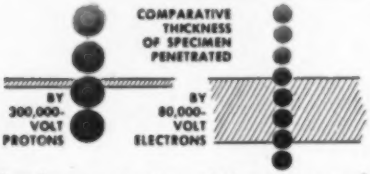
Turning electron microscope on minerals reveals, left to right, oddly spiked metallic smoke particles, new details of a gem's surface, and, at maximum power, ultra-thin fibers of a catalyst.



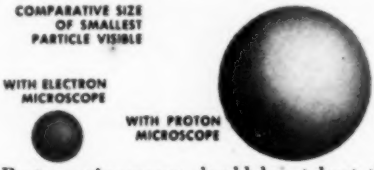
It takes higher voltage to propel protons, which have 1,840 times the mass of electrons.



Proton beam, with 1/40 the wave length of electron beam, improves resolving power.



High-voltage protons penetrate specimen only 1/10 thickness of that pierced by electrons.



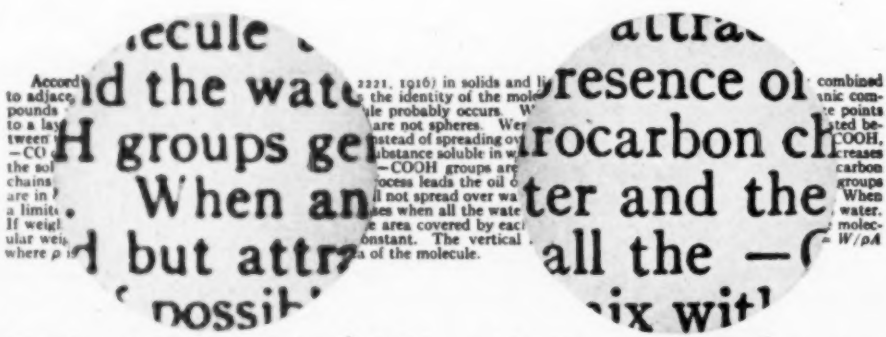
Proton microscope should be at least three times as powerful as electron microscope.

diameter. And experts say that the full theoretical power of the electron microscope, toward which they are striving, is 10 times greater.

What sets the limit of a microscope's power? Simply by making its tube longer, a designer can give you any magnification you ask. But what really interests you is "resolving power," or ability to give clear-cut outlines. This is what determines the smallest object a microscope can possibly reveal. And its *useful* magnification is the number of times that this object is smaller than the tiniest pinpoint the unaided eye can see—which is an object of 1/250 to 1/125 of an inch in diameter, such as the larger amoebas and "slipper animalcules" found in pond water.

Using ultraviolet light and photography, the most powerful optical microscopes reveal objects such as bacteria as small as 1/250,000 of an inch in diameter. Since this is just 1,000 times smaller than the smallest mote the naked eye can see, their useful magnifying power is 1,000 diameters. Actually, photographs may be made through these microscopes at higher magnification, to save eyestrain in examining details—*but no amount of magnification beyond 1,000 diameters adds a single detail that was not visible before.*

Electron microscopes, in contrast, attain a useful magnification of hundreds of thousands of diameters. Exactly as glass lenses focus a beam of light, their magnetic lenses focus a stream of electrons passing through a specimen, producing images on a fluorescent screen or a photographic film that



What determines a microscope's power? Enlargements above represent views through two microscopes that magnify equally. Microscope with poor resolving power gives blurred image at left. Microscope with superior resolving power gives sharp image at right. Its *useful* magnification is greater, since it makes tinier details, like shape of top of "t," clearly visible.

Improved magnetic lens, above, helps electron microscope to reveal objects as small as molecules. New feature is use of tiny screws to adjust magnetic field to near-perfect symmetry.

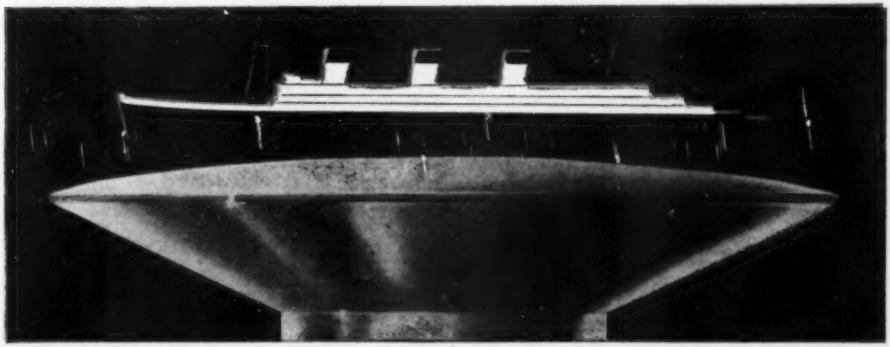
New eyepiece of RCA experimental electron microscope, the most powerful in the world, enables Dr. James Hillier to view objects directly at its full 200,000-diameter magnification.

reveal objects as small as a fraction of a millionth of an inch! At this enormous magnification, germs prove remarkable creatures with "feet" or "tails." Viruses, elusive organisms that pass through the finest filters, have been photographed at last. Bacteriophage and antibodies, mysterious things that once were only scientific theories, now can be seen in action.

First View of a Molecule

Perhaps the most sensational sight revealed by the electron microscope is one that scientists have been characteristically cautious, pending absolute proof, about proclaiming. But it no longer seems possible to doubt that globules resembling tennis balls, seen in specimens of such materials as polystyrene latex, are man's first view of molecules. Their size can be calculated from theory, and the objects seen exactly fit the prediction. Just as a camera has no difficulty in getting a picture of a person who is shivering, the to-and-fro motion of these giant molecules would be too slight in comparison with their size to interfere with taking their picture.

What wonders await microscopes of still greater power? Can there be living creatures of smaller size than any yet seen? Can we hope to peer into the molecule and see its atoms—which in hydrocarbon compounds are calculated to be only 1/125,000,000 of an inch apart? It is to answer fascinating questions like these that research workers seek new ways of seeing farther into the world of the infinitely small. END



If a pinhead were enlarged 200,000 diameters, the distance across it would exceed the 975-foot length of the *Queen Mary*, as shown, and its area would be large enough for a regiment to camp upon. The graphic comparison illustrates the amazing power of magnification of a microscope today. Now designers are striving for instruments of even greater power.

Oilmen Make Swamps Talk

SCIENCE has simplified the job of spotting new oil beds to feed a petroleum-hungry world, but the oil explorer's life is still no cinch. Before he can use the sensitive instruments that give him a picture of what lies below the earth's surface, he may have to lug them across a desert, up a mountain, or —as pictured here—through the heat-ridden tangle of a Louisiana swamp.

These men are members of a seismographic crew of the Humble Oil and Refining Co. (a Standard Oil of New Jersey affiliate), operating in the bayou country around Lake Arthur. Because boats can't get clear into the swamps, they have to back-pack food, fuel, explosives, and bulky equipment through mud and junglelike undergrowth.

Reaching a predetermined location, they set up their equipment, fire an underground blast, and record the resulting earth tremors. Then they pack up and move on to do it all over again—up to 10 times on a good day. Packs are limited to 35 pounds, and frequent rest stops ease the strain, but it's rough going for all that.

At night, the men return to the comparative comfort of a houseboat base, and every 10 days they get a four-day break outside the swamps. Then back they go again, to make the swamp spill more of its secrets—and possibly some oil.

Outboard motor head, lightweight power source, drives centrifugal pump to supply water for hydraulic drill. Water is pumped from a slush pit, dynamite-blasted out of the swamp.

Muddy drillers bore holes as deep as 80 feet, making sure explosion tremors reach subsurface levels. When hole is ready, several sticks of explosives are dropped down it, then set off.

As the blast goes off, operator rotates drum of photo recording device. Impulses from the ground pickups go through amplifiers (foreground) and are translated into light beams.

Drum of sensitized paper inside recorder gets a picture of man-made earthquake. Reflected tremors appear as a series of wavy lines, their intensity depending on the strata beneath.

Hitting the trail to start a day's operations, pack-toters leave boat at the edge of a bayou.

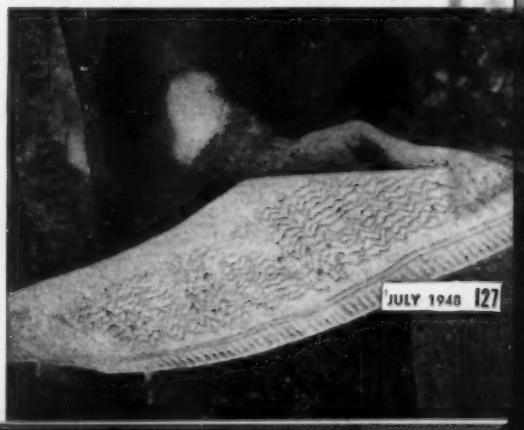
The survey crew goes ahead of the seismographic team to mark the location of each "shot."

Cable handlers lay wire along a carefully surveyed line from the apparatus that records the reflected explosion waves. This part of the operation is done while the drillers are at work.

Ground pickup phones, pushed into the soft soil, are attached to the wire every 200 feet. Thus dispersed, these sensitive "ears" gather a comprehensive pattern of explosion's effect.

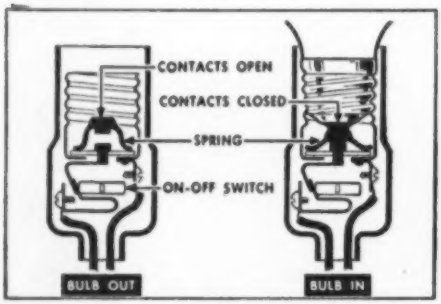
A lightproof bag becomes a portable darkroom, and the recorder film is developed immediately after each shot to make sure nothing failed. If not successful, shot is repeated at once.

The completed record gets a final OK. It looks like a graphic analyst's nightmare, but its squiggles may tell geologists the whereabouts and extent of new oil beds under the bayous.



New Gadgets Aid Home Safety

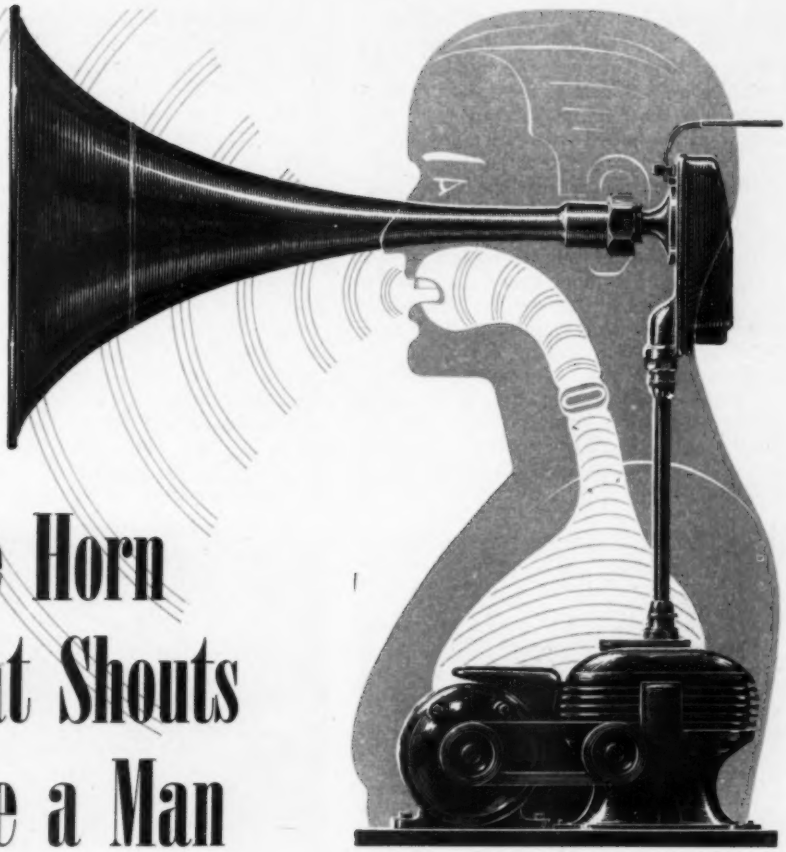
YOU'RE still risking your life every minute you stay home—in a year 33,500 people are killed, 5,000,000 injured at home, more than in automobile accidents—but applied science promises to reduce this danger. Shown here are some of the newest gadgets to eliminate common home accidents. These devices won honors in the annual safety contest sponsored by Lewis & Conger, New York hardware store. Selections were made on the basis of effectiveness, simplicity, and reasonable price.



You can't get a shock with the Non-Shock Safety Socket Ⓣ even if you stick a finger in it. In addition to the standard on-off switch, it has a second, spring-operated switch that automatically breaks the circuit if the bulb is taken out (left-hand drawing). The spring is very heavy, keeping the circuit open even if a child pushes hard against the contact. The threads on the bulb give a jacklike action that easily forces the safety switch closed, permitting the bulb to light. The safety socket is manufactured by the S-P Socket Co., of New York City.

The Signalite Ⓣ fuse tells you when it blows out by lighting a tiny neon glow lamp in the center of its handle. Turning this handle puts a new fuse element into operation, each fuse containing six elements. It is made by the Signalite Fuse Co., of Bloomfield, N. J.

A shut-off valve, controlled by a removable key, keeps children from turning on the gas jets in the new Grand Safe-Tee-Kee Ⓣ cooking range. The valve stops the flow of gas to all burners except the pilots. The new stove is made by the Grand Home Appliance Co., of Cleveland.



The Horn That Shouts Like a Man

Vocal cords of this new loudspeaker vibrate a stream of air to produce a shout that can be heard 10 miles.

By William P. Vogel, Jr.

THE loudest loudspeaker ever built works the same way your voice does—but it makes more noise than a champion hog caller locked in a telephone booth.

The Dilks Vocal-Aire ® loudspeaker, now being manufactured by two young engineers in a small factory in the little town of Seymour, Conn., talks by modulating a moving stream of air, just as your larynx modulates currents of air from your lungs. The nub of their unit is two carefully machined grids, one stationary and the other mobile, counterparts of the human vocal cords. A motor-driven compressor drives air through the slots in the grids, while the mobile grid is made to vibrate by audio impulses from an amplifier.

This sets the entire column of air directly into sympathetic vibration, and the result is a sound that can be heard 10 miles away.

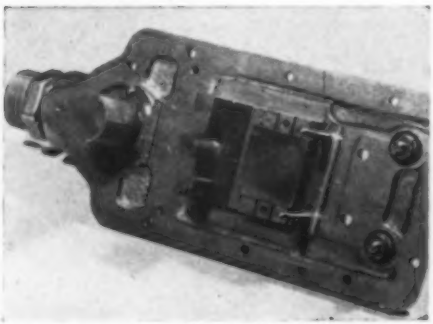
In your home radio or phonograph the voice coil of the loudspeaker vibrates the cone—really just a special shape of the diaphragm in old-fashioned earphones. The cone, in turn, sets the surrounding air into sympathetic vibration. But where high sound intensity is required the cone-type speaker is not very efficient: in the triple-play conversion of electrical audio impulses into sound waves that you can hear, a lot of energy is lost.

Because its vocal cords vibrate the air directly, a Dilks unit with a 20-watt amplifier can produce sounds many times louder than those from an ordinary speaker using the same amount of power.

During the war, the Navy, at Floyd Bennett Field, Brooklyn, got the same coverage from one Dilks speaker it could have obtained from 25 conventional horns each fed by a 20-watt amplifier. Only two Dilks units, each equipped with two horns, cover the Yale Bowl. The New Haven, Conn., fire department uses a Dilks speaker to control crowds and traffic and to give orders to firemen inside a burning building. In Arkansas an aluminum refinery recently tested a Dilks system to shout above the noise of six Diesel-electric generators. The air-column speaker works unusually well over water and also for "talking down" aircraft without radio. For airplanes themselves, the low weight-to-output ratio of the Dilks speaker makes it a natural. It can be heard farther and more clearly, with its 90 to 100 lb. of weight, than a conventional system weighing 750 lb.

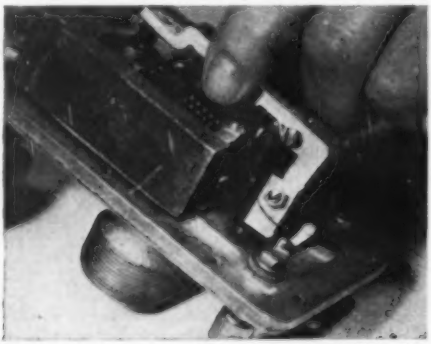
For 50 years researchers trying to devise ways of modulating an air column directly were unable to overcome high distortion and the difficulty of relieving excess air pressure. Just before the war the late Charles F. Dilks licked distortion by the design, size, and shape of the grids. He then solved the pressure problem with a delicate pressure compensator that was controlled by the distension of a diaphragm built into the housing of the voice box.

Before his patents were issued, Dilks used to cut the grids secretly, in a locked room, with a special lathe and a handmade saw consisting of 40 small circular toothed blades, of precisely graduated sizes, set along a spindle. Grids can now be cut more publicly, but the tolerances must be just as fine as in Dilks's early models. Present design of the unit calls for 40 slots in the stationary grid, 39 in the mobile grid.

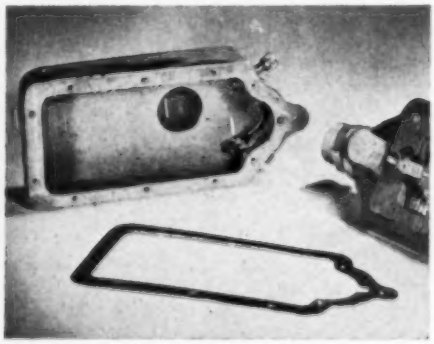


Opened voice box of Dilks Vocal-Aire ® loudspeaker shows stationary grid in place near center of plate. Its 40 narrowly spaced slots form one-half of speaker's set of vocal cords.

Mobile grid is put in place. Holes let air flow through smoothly. Below them, out of sight, are slots and reeds to fit over those of the fixed grid. Spur at its right is steel armature.



Pressure-compensating arm is attached to the mobile grid. It prevents excessive pressure of the air from holding the smoothly planed grids together and thus locking the mechanism.



Housing of voice box is made of bronze coated with zinc. Dark circle on its inner surface is rubber diaphragm that moves pressure compensator. In foreground is air-seal gasket.

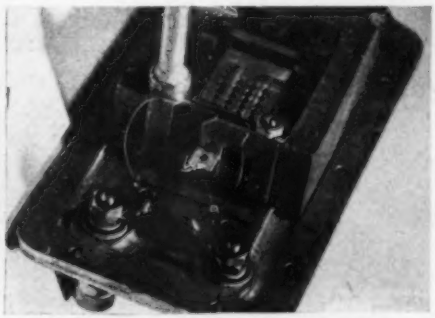
The slots are .006 inch wide and are spaced .015 inch apart. The touching surfaces of the grids are ground and lapped to a high degree of flatness, so that when the reeds of one are mounted over the slots of the other a perfect air seal results.

The free end of the mobile grid carries a steel armature, which floats between the poles of a magnet that makes the grid vibrate when audio pulses flow through the voice coil. Here, again, close tolerance is necessary; the armature must clear the lower pole piece by .001 inch and the upper one by .006. Thus, when the speaker is operating, the mobile grid will float free in its vibrating range of .002 inch without hitting either pole pieces or stationary grid. If it did hit, the resulting "chatter" would destroy tone quality and intelligibility.

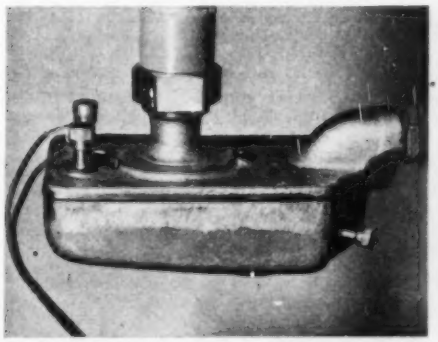
When his company was reorganized last fall after Dilks's death, William Petzold, 29, chief engineer, and Frank Holdenecker, 35, factory superintendent, bought some of the assets and patents, and set up shop for themselves on the banks of the Naugatuck River. There, where they can test their units on high power without scaring too many dogs and chickens, they are making and selling standard Dilks units, as well as a new portable rig.

Their big research problem—which, for lack of rules to go by, they must attack by cut-and-try—is to get higher fidelity. At present their speaker doesn't respond to very low tones. Its frequency range of from 250 or 500 cycles up to 5,000, depending on the size of the horn, compares unfavorably with the 50 to 8,000 cycles in high-fidelity radios. This gives the Dilks unit a deep enough base for human speech, but its makers do not recommend it at present for high-quality musical reproduction. END

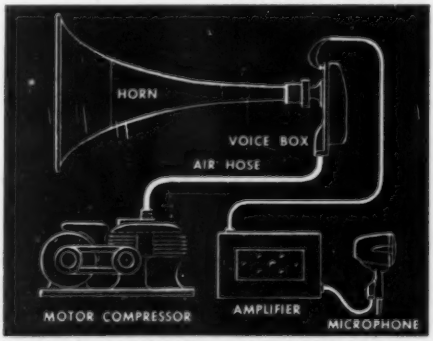
Poles of magnet are slid into position (see photo at right for final arrangement) above and below armature, which now sticks through the round, flat voice coil enclosed in plastic.



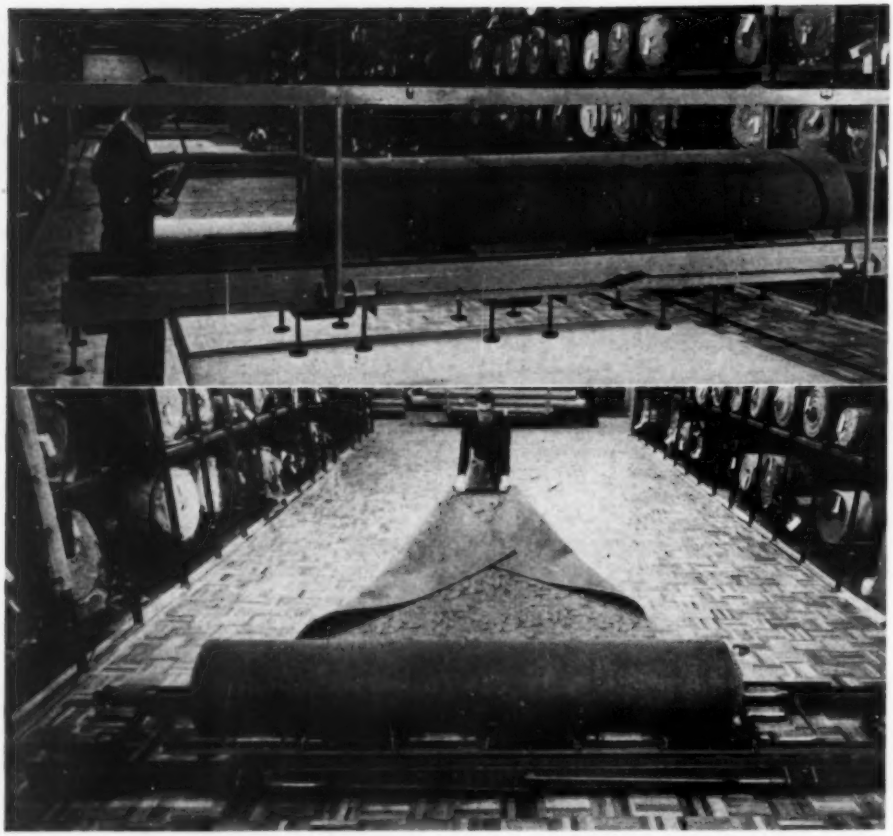
Buzzerlike setup of coil, magnets, and armature causes mobile grid to vibrate in time with audio pulses relayed from microphone. This motion then vibrates air passing through grids.



Assembled voice unit has connection at left from the amplifier to the voice coil; coupling at right is for the air hose from the compressor. At its top is the stem of the loudspeaker's horn.



How it works: Audio pulses from mike, relayed by amplifier, vibrate grid in voice box. Vibrations are transmitted to stream of air from compressor and go out through horn as sound.

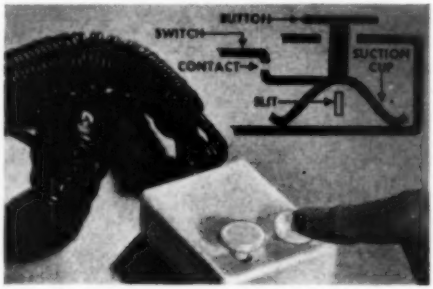


Crane Aids Rug Cutter

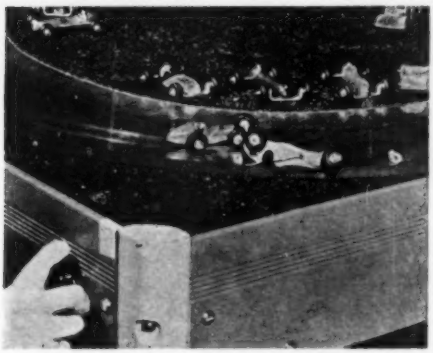
WITH this Cradle System Ⓣ you can be king of the rug cutters—literally. One man using its combination crane and cutting table can handle rolls of carpeting up to 30 inches thick. In storage, each roll rests in its own cradle: three strips of heavy duck webbing on a steel frame. When the cutting table, suspended from a single track along the ceiling, is swung end-to-end with the storage compartment, the cradle slides onto the table on ball-bearing rollers. As the table is lowered to the floor, the 16 plungers, visible in the top photo, lift the roll off the cradle. The carpet then can be unrolled for cutting. Afterward, the roll is returned to its bin by simply reversing the operation. The crane-and-cradle can be adapted to handling other bulky goods.

Button Cuts Radio Gab

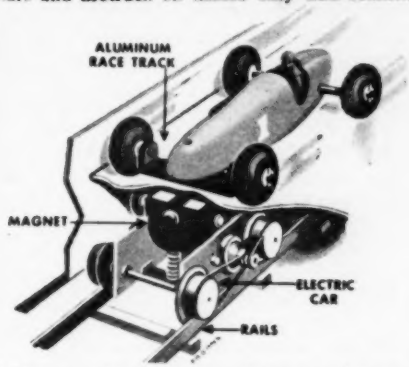
Now you can listen to the radio without having to listen to the commercials. The button switch at right, called Commercial Control Ⓣ, plugs into the power circuit between wall outlet and radio. When either button is pushed, a suction cup holds the switch open until enough air leaks through the slit to close the gap. One button cuts off the radio for 30 seconds; the other extends the silent period to a minute and a half.



Scale models of big-time racing cars whizz by judges' stand at speeds up to 7 m.p.h.—the equivalent, for their size, of 160 m.p.h. Cars and **firetruck** on infield only add realism.



Crack-up occurs when lead car skids on a turn. Racers have 2¾-in. wheelbase, solid rubber tires an inch in diameter. Speed is regulated by throttle knob for each car at end of table.



Each racer is pulled around the speedway, as shown in this cutaway view, by attraction of its front axle to a magnet mounted on an electric car that runs on rails under the track.

Tiny Cars Race Like Big Ones

A RETIRED auto racer has turned his old love into a parlor game that takes the same kind of skill as the real thing—and provides the same kind of spills and thrills.

He's Lou J. Fageol, of Detroit, who, with his brother Robeley, has patented the Jr. Midget Speedway Ⓣ pictured above. Their R. D. Fageol Co. sells both the complete outfit—$200—and kits for building your own racing cars.

Two people play the game on a table about half the size of a table-tennis court, with a third as judge to call fouls, count the laps, and time the races.

The trick is to take the curves fast enough to win but not so fast your car skids. That happens when centrifugal force overcomes the force of the magnet pulling it around the track. Result: a spill—or, if your car gets in the way of the other, a foul.

World's First Clam Farm

By Lester David

UNLIKE oysters, which have been cultivated commercially since the Romans planted the first beds in 100 B.C., clams have avoided domestication by hardihood and quick footwork.

Relatively quick, that is; for they can burrow but a few inches into mud or sand in the 12½ hours between low tides. Compared with an oyster's willingness and need to stay put for five years while growing from embryo to market size, this wanderlust and the existence of plentiful natural supplies were among the factors that discouraged attempts at clam planting—until this year.

Now, on the tidal flats of Cape Cod, the villagers of Barnstable, Mass., aided by scientists of the Woods Hole Oceanographic Institution, are tending the world's first clam farm.

The project was born of desperation.

For years the townsfolk of Barnstable had watched with dismay the gradual decline of their once-prosperous clam industry. The clam beds around the Cape, formerly treasuries of abundance, lay almost empty from years of digging. So, with long faces, the Selectmen of the village gathered at the Town Hall one day last year to discuss the problem. And out of the gloom came the suggestion: "Let's put it up to the boys at Woods Hole. There's nothing they don't know about marine life. Maybe they can think of something."

That something took shape early this year in the form of five 15-acre plots staked out on a mud flat washed by the salt tides of the Atlantic. One plot was plowed, the second spaded, the third raked, the fourth fertilized with a layer of sod and peat from the marshes, and the fifth left as it was.

Small clams for seed were imported from Boston harbor. There commercial clamming is prohibited because of polluted water, so they could be dug without violating the conservation laws that forbid removal of baby clams from most areas. The pollution didn't hurt them as seed, since live clams purify themselves in clean water.

As seed clams were sorted by size, a hacksaw blade in board scratched each shell. Later, growth can be measured by the number of rings on shell that have appeared outside scratch.

Each of the new farm's five plots was seeded with 200 bushels of baby clams.

And now the clam farmers, and their scientific advisers, are watching and waiting. So far, the clams—which feed on tiny marine plants and animals—seem to be doing best in the fertilized plot. If the harvest bears out that indication, larger fertilized fields will be planted next year.

Meantime, at their present rates of growth in all the plots, the 1,000 bushels of seed clams are expected to yield 2,500 bushels of soft-shells for market this year. If they do, science will have done more than rescue the clam diggers of Barnstable from unemployment. It will have shown how barren tidal flats in many parts of the world can be farmed to feed hungry people.

Clams were planted by scattering them over mud flat at low tide. By the next low tide, all but the largest had dug into the mud. Those were then buried by hand—and stayed alive.

By trying different ways of preparing each of five plots, "farmers" hope to find out what soil treatment is best to speed growth of clams and to keep them from wandering or washing away.

Navy Camera Makes Light Look Slow

Dr. A. M. Zarem holds a Kerr cell in front of camera with which he uses it to take world's fastest pictures. Camera itself might be any standard type; here it's a Speed Graphic Ⓣ.

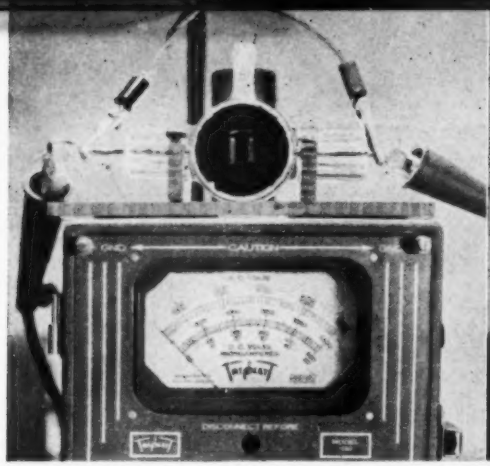
NO OBJECT can move as fast as light. So there's literally nothing worth photographing that cannot be stopped by a camera almost as fast as light. The U. S. Navy now has such a camera. In the time it takes to snap one picture—1/100,000,000 of a second—light travels only about 10 feet.

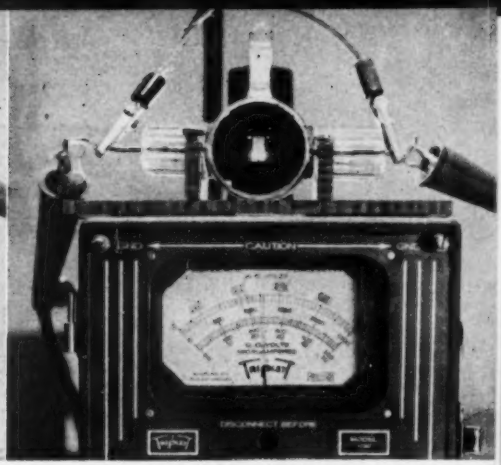
Pictures at this record speed are made with a shutter that has no moving mechanical parts—only moving molecules. These are in a Kerr cell: a glass tube filled with nitrobenzene, an oily liquid with a bitter-almond odor. When the nitrobenzene is shocked by a high-voltage current, its molecules line up in a way that changes the polarization of light passing through the cell. This effect was discovered back in 1875 by John Kerr. Now Dr. A. M. Zarem, of the Naval Ordnance Test Station at Inyokern, Calif., has made the Kerr Cell into a camera shutter.

The camera has three polarizers: two ordinary polarizing sheets, set "crossed" so that no light can pass through both, and, between them, the Kerr cell. When a high voltage hits the Kerr cell, it changes the polarization of light from the first polarizing sheet so that it *can* pass through the second—and register on the photo film.

Since the molecules stay lined up only as long as the high-voltage pulse lasts, a very short pulse lets light pass through for only a very short exposure.

Expansion of heated platinum wire, in three pictures below, was photographed with setup shown at bottom of opposite page. Each exposure was 1/25,000,000 second. Same pulse went to all three Kerr-cell shutters, but over cables differing in length by 2½ ft. Electricity crosses 2½ ft. of cable used in 1/10,000,000 second, so photos are 1/10,000,000 second apart.





Demonstration shows that Kerr-cell shutter (dark circle on top of voltmeter) lets light through only when current is on. At left: no voltage, no light visible through shutter. But when current is on (right), cell shifts polarization of light and lets it go through shutter.

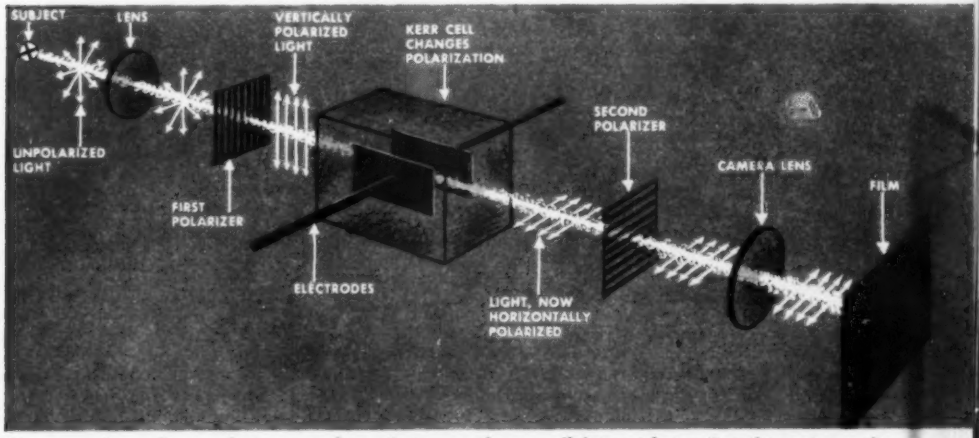
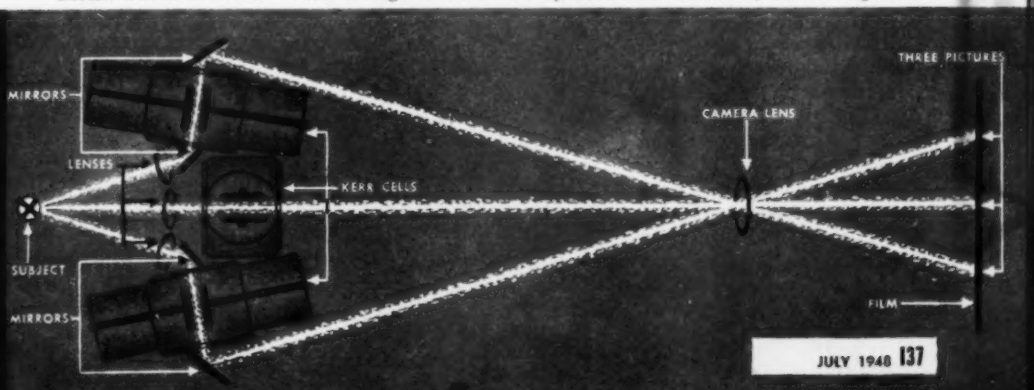
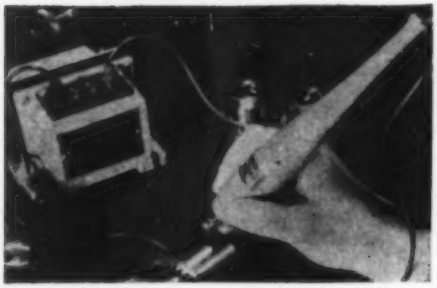


Diagram shows how polarizers work as shutter. Unpolarized light is like many-spoked wheel moving sideways. First polarizer, like picket fence, lets through only single pair of spokes parallel to pickets. But this pair won't go through second fence (second polarizer) because its pickets run wrong way—except when Kerr cell tilts spokes to line up with them.

To make the "movies" of expanding platinum wire, shown on opposite page, a series of Kerr-cell shutters was set up—one for each frame. Sketch below shows how the arrangement of three cells and mirrors made three successive pictures of same action. In this way, photos can be taken that show step-by-step progress of nearly instantaneous events, such as explosions.



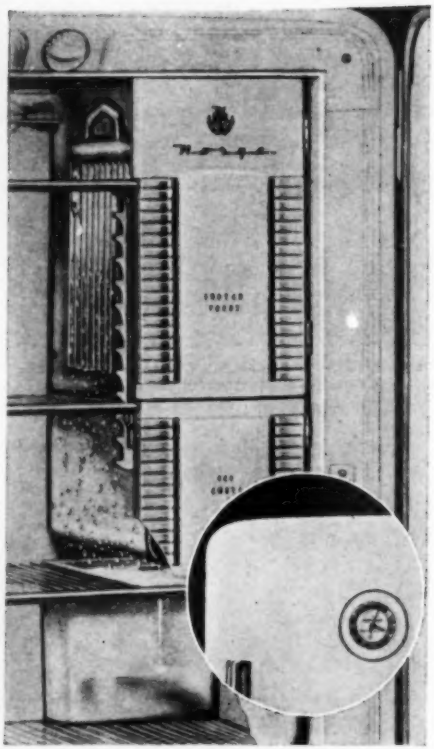


Pen Writes on Steel

ELECTROMAGNETS in the handle of this new British pen, made to label steel parts, vibrate a spring tipped with an etching needle. Touching the point to the metal surface closes the circuit and sets pen going.

Car Tags Show at Night

CONNECTICUT is the first state to cover its license plates with a new plastic film, called Scotchlite®, for better visibility at night. You can see the difference in this photo of the tag issued to the editor of POPULAR SCIENCE alongside an old-style marker. Tiny glass beads in the film reflect light from approaching automobiles.

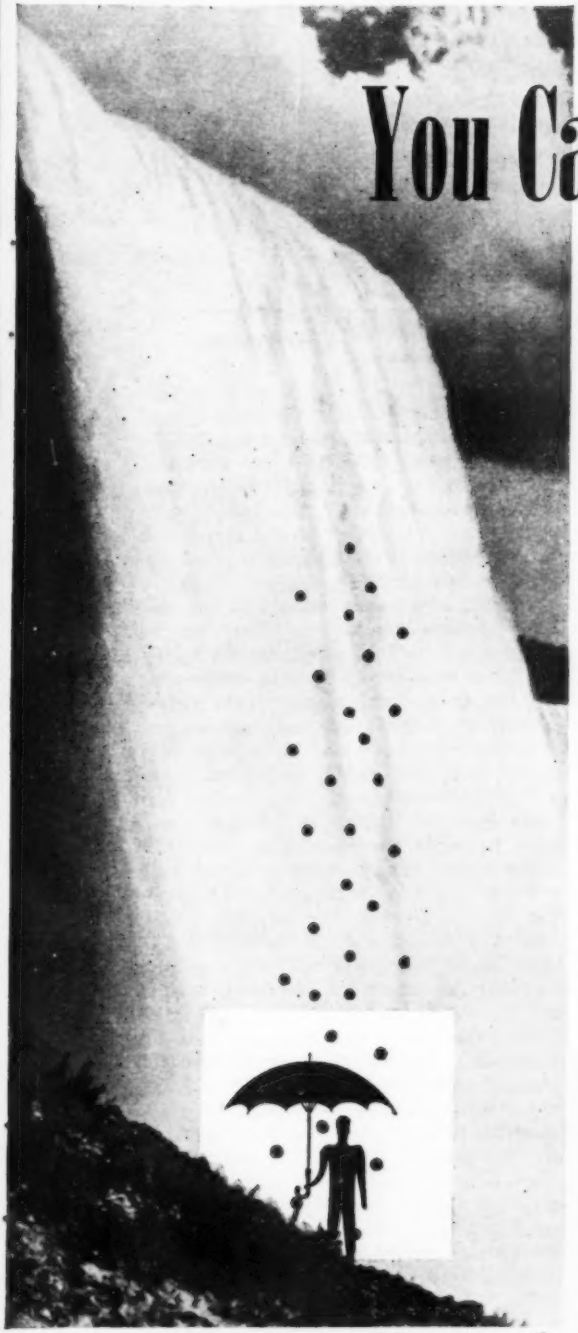


Refrig Defrosts Itself

AN ELECTRIC clock (inset) in the door of the new Norge refrigerator turns it off for three hours every night. This saves electricity, as well as time and muss, since ice melts off the freezer before it can build up into an insulating coat. Water drains into a deep tray that fills up only once a week and is easy to empty without spilling.

Bus Has Buffet

LUNCH counters with steward service (right) in buses now save stops for snacks between meals on cross-country runs. American Buslines has put the new motor coaches on express routes out of New York, Chicago and St. Louis. Another feature to speed schedules is an airplane-type washroom in the rear of the bus, with toilet facilities and outlets for electric razors.



Like droplets in a waterfall, atomic particles cascade to earth from outer space in a continuous shower, splitting as they collide.

You Can't Escape Cosmic Rays

So let's take an imaginary flight and meet more of these tiny bullets that constantly rain down on us.

By Martin Mann

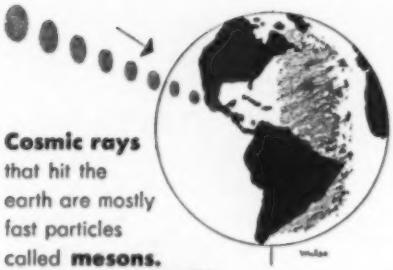
YOU are sitting in the rain right now—a rain of atomic particles. You cannot see, smell, or feel them. But they are showering you and everyone else day and night, winter and summer.

They are cosmic rays. Although they were discovered about 35 years ago, scientists have only recently learned just what they are and a little about what they do. No one knows yet exactly where they come from.

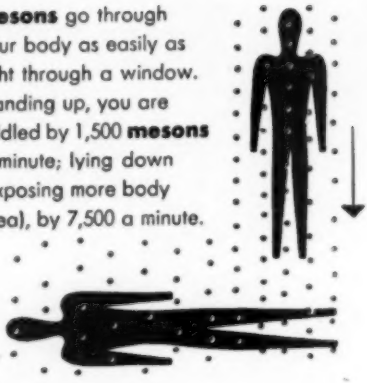
Although these powerful cosmic particles pass through your body every second of your life—and they are much like the particles that come from an exploding atomic bomb—they apparently do not hurt you. The medical men reason that the human race, during many centuries of exposure to this much radiation, has become adapted to it.

Cosmic rays, while very powerful individually, are spread out more thinly than the radiation from an X-ray machine or the horrible new bomb. They are comparable, in fact, to the drops of rain that fall at the start of a summer shower—heavy, but widely spaced.

Recent experiments with mice indicate, however, that cosmic rays may not be quite as harmless as most of the experts have thought. At the University of Maryland Medical School, Dr. Frank H. J. Figge arranged eight cages of mice so that they received varying amounts of cosmic radiation. Some of the cages were covered with lead plates, because lead intensifies these rays.

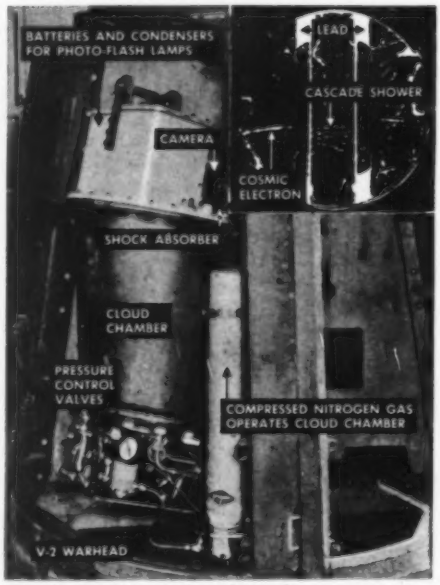


Cosmic rays that hit the earth are mostly fast particles called **mesons.** At sea level, an area this size [redacted] is struck by one **meson** every minute.



Mesons go through your body as easily as light through a window. Standing up, you are riddled by 1,500 **mesons** a minute; lying down (exposing more body area), by 7,500 a minute.

Other cages were not covered, so that the mice in them would receive only the normal amount of radiation. Dr. Figge then injected all the mice with methylcholanthrene, a chemical that induces cancer. In the cage receiving the most concentrated dose of cosmic rays, 21 of the 23 mice developed cancer in 10 weeks. In the worst of the uncovered cages, only 10 mice had developed cancer during the same period.



War-built V-2 rockets have become a major tool in cosmic-ray research, taking instruments like this Naval Research Laboratory cloud chamber to new heights. Unit shown above photographed cosmic ray tracks every 25 seconds on a 98-mile flight. Inset shows one of pictures it made. They were recovered from film cartridge that had buried itself six feet into ground.

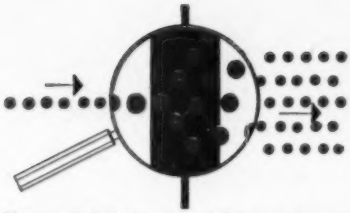
Dr. Figge is careful to point out that this one experiment only indicates something worth further investigation. It by no means proves that cosmic rays cause cancer.

There are ways in which the atomic particles from out in space certainly affect you. When they enter the upper part of the atmosphere, they transmute some of the nitrogen there into a radioactive form of carbon called carbon 14. It is just like the carbon 14 that is manufactured now in atomic piles. But this carbon 14 is present in the air you breathe (as part of the carbon dioxide), and gets into your body and stays there. Nobody knows whether this hurts you.

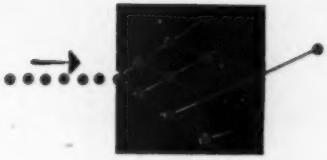
Such recent discoveries as this may turn out to be merely interesting tidbits of knowledge, with no practical value. But other things learned from cosmic rays already have proved tremendously important. Some of the knowledge that enabled physicists to produce the atomic bomb was acquired by studying cosmic rays. So they are being studied a lot more now, and there's no telling what will come of this work.

Suppose we take an imaginary trip—a very imaginary trip—into space to observe this mystery with the scientists. Since we cannot see cosmic rays, we will take a cloud chamber with us. It's a device with which the particles can be tracked and identified. We'll also take a Geiger counter to count the rays. Our guide on this strange tour will be Dr. Walter Heitler, cosmic ray expert from the Institute of Advanced Studies in Dublin, Ireland, who is now a visiting professor at Columbia University.

Dr. Heitler suggests that we follow the rays down through the atmosphere as they approach the earth. All right, let's keep our



Thin metal plates intensify cosmic rays by the **"cascade effect."** One meson gives a fast electron, which emits **photons** when it collides with a metal **atom.** The photons turn into **electrons** when they in turn hit atoms. Thus the number increases, but the energy decreases.



Thick metal plates cut down cosmic rays. At first, the **cascade effect** intensifies them, but these cascade showers die out inside the metal plate, lacking enough energy to continue the **electron-photon transformation.**

imaginary space ship going until it leaves the atmosphere, about 200 miles up. That is higher, of course, than anyone has actually traveled or even sent instruments. But scientists are pretty sure that out here, where the wide open spaces really begin, the cloud chamber will catch the tracks of protons (the positively charged particles found in atomic nuclei) and probably little else. Proton tracks can be distinguished from others in the cloud chamber because a proton is about 1,845 times as heavy as an electron and its track curves in the direction of positive charge.

These protons are the things that come from far away. Physicists call them the "primary" radiation. They come fantastically fast, with energies as high as a million billion electron volts. Even the new atom-smashing machines now being built (PS, Jan. '48, p. 113) will reach only one billion electron volts.

Bombardment Increases Near Earth

Now let's follow these high-powered protons down to see what happens when they smash into the earth's atmosphere. The air does not become thick enough to make much difference to the protons until they're down to within about 34 miles of the earth. Near that point, however, our Geiger counter begins to click faster, recording an increasing number of rays. And the tracks of different kinds of particles appear in the cloud chamber. Our space ship is now being bombarded not only by protons but also by electrons and neutrons—two other components of ordinary atoms—and by several mysterious particles called mesons or mesotrons.

Dr. Heitler explains that in this part of the atmosphere there are enough atoms of air—oxygen and nitrogen—to get in the way of the high-speed protons from outer space. As protons bang into these atoms, they knock loose their outer clusters of electrons. And some of the protons may penetrate to the nuclei of the air's atoms and smash them open, turning loose the protons and neutrons in their interiors.

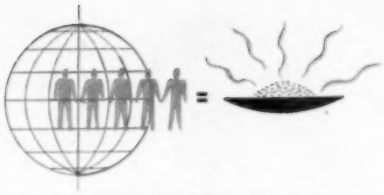
How Mesons Are Born

The mesons, however, are actually created rather than blasted out of something already existing. A high-speed proton passing close to a neutron, loses some of its speed energy. This speed energy is converted into mass (it's as though an atomic bomb worked backwards), and a negative charge from the neutron hooks onto the new mass. Where originally there were two fast particles, a proton and a neutron, there are now three: a slower proton, a proton made from the old neutron, and a meson.

Mesons may also be created by collisions between two protons, yielding a meson, a proton, and a neutron. And scientists have found, furthermore, that there are several different kinds of mesons. The first type discovered weighed about 200 times as much as an electron. In the last few months, however, mesons that weigh 350 and 800 times as much as an electron have been found, and the physicists expect to turn up still other varieties. These mesons can have a single negative charge (like an electron), a single positive charge (like a proton), or be neutral (like a neutron).

As we ride down through the atmosphere in our imaginary space ship, the Geiger counter clicks faster and faster. More and more of the primary protons are being stopped by atoms of air, and more and more

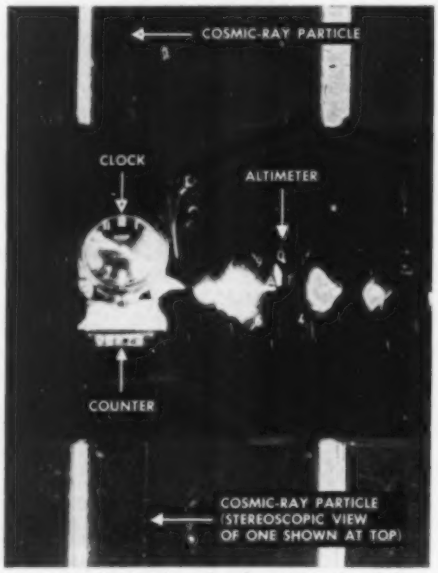
You eat **radioactive meals** because of cosmic rays. Radioactive carbon, produced from the air's **nitrogen** by cosmic rays, is in all animal and vegetable carbon.



But a little **radioactivity** doesn't seem to hurt us. The normal human body even contains some **radium.** There's more than half an ounce in the world's total population.

electrons, protons, neutrons, and mesons are appearing around us. This secondary radiation, in turn, creates more cosmic rays. The secondary protons, you see, produce the whole list of cosmic particles, just as the primary ones do. And the neutrons and mesons can also ionize and break up atoms.

But Dr. Heitler calls our attention, as we descend, to some new kinds of pictures in the cloud chamber. One type shows the death of a meson. Mesons, like radium and similar substances, are radioactive. They decay into an electron and a neutrino (a neutral electron) after a lifetime of only about two-millionths of a second.



New cloud chamber developed by Dr. Robert B. Brode of University of California makes pictures like one above. Top and bottom sections are stereoscopic views of track of same cosmic particle, permitting measurement of track's inclination. Center part shows clock, instruments.

These decay electrons travel very fast, and they cause the second new type of picture in the cloud chamber. This picture looks like a heredity chart—the streak of a single electron branches again and again until there is a host of new particles. This is called cascade radiation.

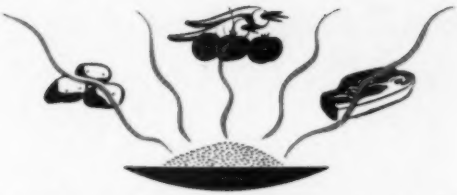
Mass into Energy—and Back

In a cascade, a high-energy electron hits an atomic nucleus and emits a photon, which is a tiny package of pure light energy. Photons consist of energy alone and do not have weight like other particles. When they hit atomic nuclei, they change back into electrons. Then those electrons emit more photons, and so on and on.

These processes fill the sky with particles of all kinds. This shower from the heavens is thickest, however, about 12 miles above the earth. As our space ship moves down lower than that, Dr. Heitler points out that the Geiger counter registers fewer and fewer particles because the atmosphere is becoming dense and the cosmic energy is thinning out. By the time we reach the earth, the tremendous energy originally present in the primary protons has been divided and redivided so many times that relatively few individual particles are powerful enough to continue through the air, and the Geiger counter clicks only a few times a second. Most of these clicks are caused by mesons.

If we unloaded the Geiger counter and cloud chamber and carried them down into a coal mine, Dr. Heitler adds, we would find that the cosmic rays lessened as we descended, because the earth too absorbs them. About a mile below ground, the rays would disappear almost completely.

Learning these things has taken a long



The human body also has about 10 ounces of **potassium,** in which foods like these are rich. About one part in 1,000 of this is naturally radioactive **"potassium 40".**

So **radiocarbon** from cosmic rays makes the third radioactive substance in the body. It produces less radiation than the **potassium 40** but more than the **radium.**

time, much expert craftsmanship, and some very fancy head-scratching. About 50 years ago, when Becquerel and the Curies found that certain elements were radioactive—that is, that they emitted strange particles—scientists began to look for radioactivity in whatever was handy, even the air. They found it, too. So they supposed that there was a trace of some radioactive substance in nearly everything—the earth, air, water, buildings, and so on.

Then a couple of very inquisitive fellows, V. F. Hess of Austria and W. Kolhorster of Germany, sent their instruments up in a balloon. They reasoned that the radiation detected should diminish as the balloon went farther away from the earth. But it didn't. The higher the balloon rose, the more intense the radiation became. So there was only one plausible explanation: the radiation came from somewhere out in space.

A Japanese physicist, Hideki Yukawa, was responsible for the next big advance, though not working on cosmic rays at the time. He was trying to figure out why the nucleus of an atom stays in one piece. His computation of the force necessary to hold it together revealed that it was a type of force that could be represented by a particle. That particle, he said, should weigh about 200 times as much as an electron, have a single negative charge, and last only a few millionths of a second.

So the cosmic-ray experts began looking for such a particle, and Dr. Carl D. Anderson of the California Institute of Technology soon found it. Dr. Yukawa had forecast the existence of mesons.

The most recent discoveries resulted indirectly from World War II. Two of the deadliest weapons ever devised, the B-29 plane and the V-2 rocket, enabled the physicists to measure cosmic rays at altitudes higher than were previously attainable.

Flights by Dr. Anderson in a B-29 made a pretty sure thing out of what had been a strong suspicion: the basic radiation from out in space is almost exclusively protons. And V-2 experiments directed by Dr. James A. Van Allen of Johns Hopkins University settled another years-old question: where does the cosmic-ray intensity level off? A 100-mile flight last July finally pegged this point at 34 miles up.

More Puzzles to Solve

There are still a lot of cosmic-ray puzzles for smart young men to answer. The most intriguing is the problem of where these rays come from. Most scientists believe they come from far outside our solar system—maybe some place in the Milky Way. There are other theories, too, such as the "solar cyclotron" proposal of Winfield W. Salisbury, research director of the Collins Radio Co., and Dr. Donald H. Menzel, Harvard astronomer. They suggest that the movement of atoms in the sun generates very long radio waves. These radio waves then accelerate particles that exist in space near the earth—in much the same way particles are accelerated in a laboratory cyclotron.

But more evidence is needed. How long it will take the scientists to obtain it no one knows. But the planes and rockets that may help them tremendously are being developed now. Scientific progress, like cosmic radiation, is overtaking us day and night, winter and summer. END

Chew a Stick of Penicillin

CHEWING gum containing penicillin and sulfa is now being prescribed for patients who are allergic to the drugs in capsule form or by injection.

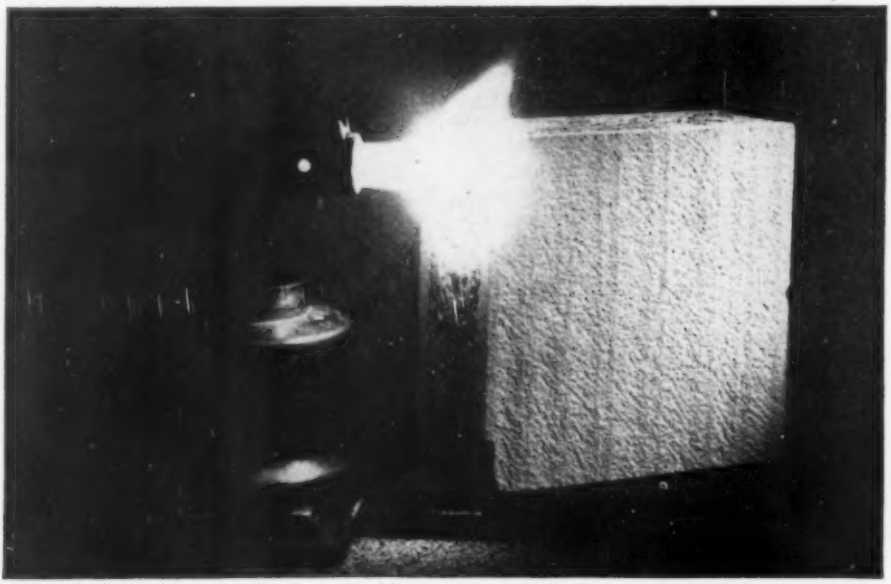
New Slabs Speed Building, Cut Cost

WHEN wood for building was scarce during the war, a Swiss chemist got a bright idea for stretching the supply: soak waste chips and shavings in chemicals, mix the shredded fibers with Portland cement, and press the mixture into slabs, panels, and blocks. The new material was widely used in Europe for houses, factories, and hospitals. Now it's being made over here.

Durisol®, as it's called, combines the characteristics of sheathing, siding, fireproofing and insulating material, and lath. Used for interior or exterior walls, it needs only half the usual number of studs; for partitions, where less strength is needed, it can be put up without framework and plastered over. It also makes subfloors, ceilings, and roofs. Its use is said to cut building time in half and, by saving labor and lumber, to trim costs 20 percent.

Durisol® slabs for making walls are 2 ft. by 4 ft., and 3⅝ in. thick. Strip of felt in tongue-and-groove joint makes it watertight. Panels and blocks for other uses are 1 to 5 in. thick.

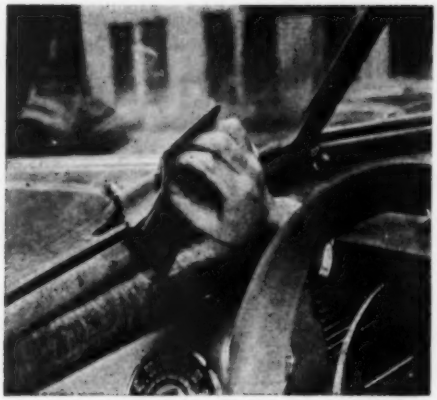
House in Belgium has exterior walls of Durisol® panels, precoated with white cement plaster as a permanent finish. Uncoated, they'll hold plaster or stucco without the use of lath.



Durisol® resists fire, as shown in this blowtorch test. It also absorbs sound, stops rats and termites, insulates five times better than bricks. It can be sawed, drilled, nailed, or screwed.

Rickshaw On Way Out?

IF THIS three-place motor scooter catches on, the boys who pull rickshaws will push throttles instead. The first model of the Rik-Mobile Ⓣ has been shipped to China for demonstration before the rickshaw associations. Developed by the China Engineering Corporation, of San Francisco, the machine is steered by motorcycle-type handlebars. Gas control is on the right-hand grip, clutch and brake in the conventional positions on the floorboard. The Rik-Mobile hits a top speed of 35 m.p.h. and does about 80 miles on a gallon of gasoline. Two speeds forward are provided.

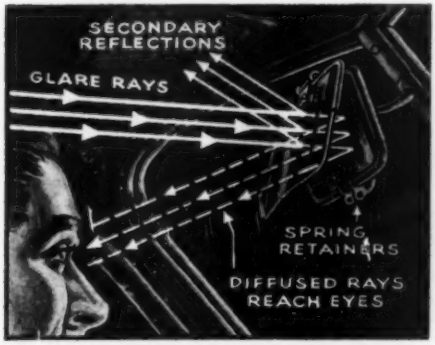


One Wipe Whips Foggy Glass

ONE wiping with this new chemically treated cloth is said to keep the windshield and windows of a car fog-free for several hours. The cloth lasts indefinitely.

Developed by the Dupont company, the antifogging agent is a solution of tannic acid, glycerine, water, and dye. The treated cloths are manufactured by the Industrial Products Company, of Philadelphia. Soft absorbent cotton cloth is soaked in the solution and then allowed to dry.

Tests have shown that the cloth also may be used to prevent eyeglasses from steaming up when you enter a warm building.



Filter Stops Rear-View Glare

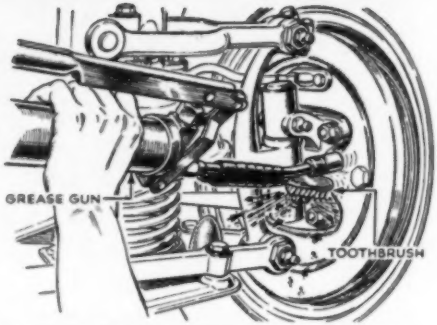
A FILTER that clamps over a rear-view mirror eliminates the glare of headlights from behind. The Edro Corporation, New Britain, Conn., makes the device of neutral-color plastic. It fastens to the mirror by four adjustable hooks. When not needed, it's easily swung up out of the way. The filter permits a normal view to the rear.

Taillight Hides Gas-Tank Cap

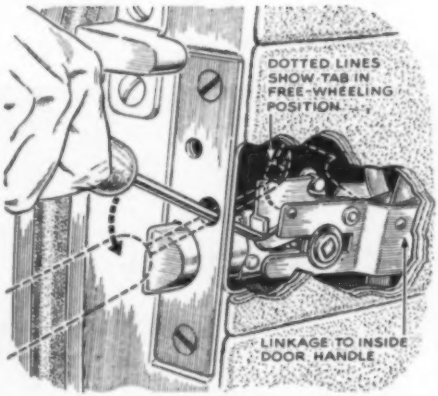
A FEATURE of the 1948 Cadillac is the gas cap, taillight, and directional signal—all built into one unit in the left rear fender, matching one of similar appearance on the right. The tank inlet is concealed beneath the light. To get to the tank opening, you push a button as shown in the photo. This allows the light to be swung up.

Hints From the Model Garage

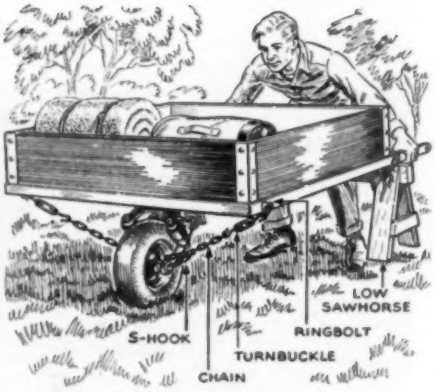
Washing Job Speeded Up. You can do a better job of washing a car if a sponge is attached to the nozzle of the hose. Cut a blind hole just large enough for insertion of the nozzle. Run heavy cord through with a needle and tie to the hose.



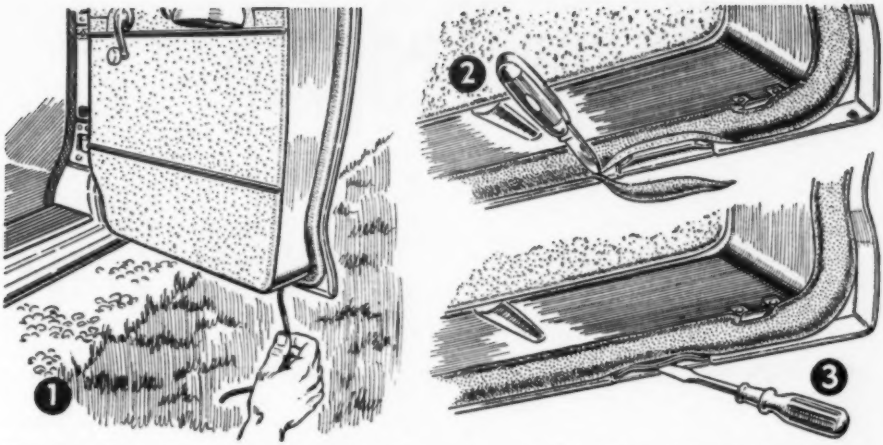
Brush Off the Fitting. An old toothbrush with stiff bristles is ideal for cleaning grease and embedded dirt from grease fittings before applying the gun. For greater working convenience, tape the handle of the brush to the nozzle of the gun.



Keep Children Safe. Did you know there's a safety feature in the rear doors of General Motors four-door sedans? With a pointed tool (for instance, an ice pick with the point slightly bent), you can adjust the lock so the inside handle won't open the door. The handle is as easily returned to operation. GM introduced these locks in 1941. They've been used ever since in all models except '46, '47, and '48 Buicks.

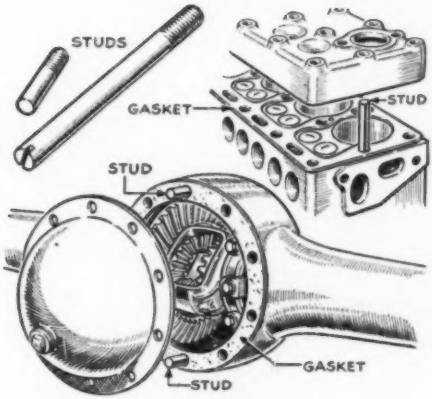


Trailer Used as Wheelbarrow. It's difficult to handle a caster-type trailer when detached from the car. F. W. Sewell, of San Mateo, Calif., overcame this by rigging his like a wheelbarrow. A ringbolt was attached to the body at each side. When the trailer is to be moved, removable chains with S-hooks in each end keep the wheel rigid. Turnbuckles tighten the chains. A sawhorse supports the trailer.

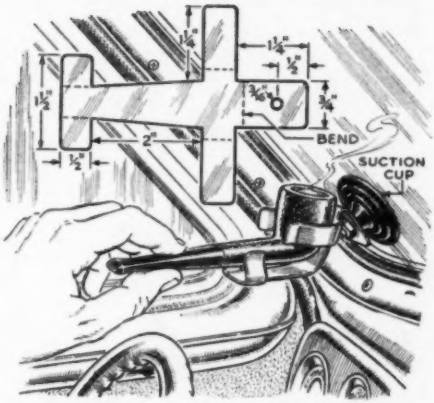


Drain Slots Need Cleaning. You should check over the drain slots in the door and body panels of your car occasionally. Otherwise, pent-up water may rust the metal.

For a thorough job, it's best to have the car on a hoist. However, you can locate the slots by feeling under the edges. Clean them out (1) with a piece of wire. In some cases, you may find that the weatherstrip laps over the slot, preventing proper drainage when the door is closed. The simplest remedy for this is to cut away a slice of weatherstrip (2). Occasionally, the flange around a slot also may be crimped shut. If so, pry it open (3) with a screwdriver.



Special Studs Align Parts. In the garage where A. G. Patrick works in Hot Springs, Ark., you'll find a small box containing bolts of various sizes. These are not ordinary bolts, however. The head has been removed from each, and slots have been cut in some. As illustrated, these are often useful for keeping parts aligned during assembly. With several screws in, studs are removed with pliers or a screwdriver.



Clip Supports Your Pipe. If you smoke a pipe while driving, you can give your jaws a rest occasionally with this clip. Copper or aluminum is easiest to work, but brass is more springy and makes a better clip. Using the pipe as a guide, bend the metal to shape. A suction cup with a screw molded into it can usually be found in an auto store. The clip was designed by Arthur Trauffer, of Council Bluffs, Iowa.

Gus Races Trouble to the Wire

At a tough, hard-fought motorcycle run, he plays a fast hunch for a winner.

By Martin Bunn

"HEY!" Stan Hicks yelped. "What's that?"

"It sounds like the Battle of the Bulge," Gus told him unexcitedly. "But it's just a ham motorcyclist who thinks he's going fast because he's making noise."

The ear splitting ceased. Through the shop door a tall young man pushed a motorcycle. He wore helmet, goggles, and a wide, rivet-studded belt.

"Ah!" Gus greeted him, with mock deference. "Zipp Temple, speed demon!"

The young man flashed a brief grin. "Mr. Dunlap told me to bring my bike to you."

Stan had been regarding Temple with disfavor tinged with envy. "This ain't a cycle shop," he growled. "Mr. Wilson don't bother with them—do you, boss?"

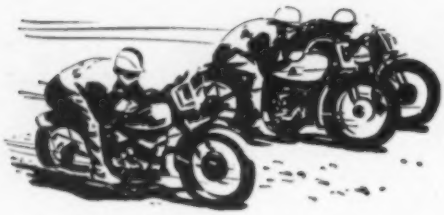
"Well," Gus hedged, "I haven't worked on one for a long time, and I haven't ridden once since the days—" He broke off to light his pipe.

"Huh?" Stan prompted.

"Never mind," Gus said disappointingly.

Most of the regulars around the Model Garage know that Gus and Bill Dunlap, the perennial president of our town's Acme Motorcycle Club, used to compete when

Gus faced the big rider. "If you pull anything," he warned grimly, "you'll have me to deal with."



they were topflight riders back in the early Twenties. But we've never been able to learn much about Gus's riding career; he's never one to talk about himself.

"Mr. Dunlap said you'd try to speed up my bike," Zipp said importantly. "I need all the speed I can get. I'm riding for th' Acmes in th' championship Saturday."

Gus nodded. "Yes, Bill told me when he phoned." He looked the rider over appraisingly. Dunlap had also said that Zipp was a careless motorcyclist. The reason he was going to ride for t..e Acmes was that quiet Tom Dorsey, who'd beaten him with a lap to spare in the trials, had later injured his shoulder and wrecked his machine. "Cocky as all get out," Gus sized Zipp up.

He turned to the machine, a high-compression twin with overhead valves. A large, straight pipe had been substituted for the muffler. Gus ran a rod into the pipe and found no baffles inside it. "How long you had this thing on?" he demanded.

"Oh, a couple of weeks," Zipp told him. "A fellow at our shop welded it on for me. You can't get nowhere with a muffler on."

"There's a law against running without a muffler," Gus said, "and there ought to be. You fellows who ride motorcycles that sound like machine guns give a good game a bad name. And you're fooling yourself if you think you go any faster. You just make so much racket you think you do. Well, how's she running now?"

"Not so good," Zipp conceded. "She ain't got nearly the moxie she ought to have."

Gus grunted. "I'll take a little ride—if I remember how." He straddled the machine, strode the starter down, and rode out of the shop with confident smoothness.

Five minutes later he rode in again and swung off. "Feels like a compression leak," he said. "It might be bad rings or even a broken piston. More likely it's valve trouble."

"I'm broke right now," Zipp said.

"The club's taking care of the job for you," Gus told him with a grin.

"Okay," Zipp said, and swaggered out.

As Gus removed the plug from the front cylinder, Stan brought him the compression gauge. "Stand on the kick-starter," Gus directed when the gauge was fitted to the plug hole. He watched the indicator hand swing to the 15-lb. mark and stop. The rear cylinder gave the same result.

"Compression leak in both cylinders." He poured a spoonful of heavy oil into each cylinder, directed Stan to kick the engine over a few times, and tested again. The pointer stayed low. "It's not the rings."

"How do you know?" Stan asked.

"Heavy oil would temporarily seal off leakage past the rings," Gus explained. "If the rings were bad, we'd have gotten a much higher reading with the oil. Let's have a look at those valves."

They set to work taking the engine down. Removing the first exhaust valve, Gus held it up for Stan to see. "Warped. I expected it when I saw that nitwit had taken off his muffler."

"Wait a minute," Stan pleaded. "What's a muffler got to do with valves warping?"

Gus pointed an accusing finger at the flaring tailpipe. "An exhaust as big as that, without any baffles in it, sometimes causes an intermittent vacuum around the exhaust ports that blocks heat transfer from the valves. At high speeds they are more likely to burn."

He tossed the valve into a junk box. "No sense in wasting time with them. Run down to the motorcycle shop and get a new muffler and a set of valves. Then we'll tune her up as well as we can. If Zipp doesn't win, it'll be his own fault."

SATURDAY afternoon found Gus out at the Fair Grounds. To his experienced eye the Club's two-mile course offered a wide variety of potential grief. The first few hundred yards were on the half-mile dirt track. Then there was a sharp turn and dizzy dive into a dry stream treacherous with sand and rocks. The trail clawed steeply up the bank, into another abrupt turn and a series of roller-coaster hills, followed by a long stretch deep with loose sand. Twenty-five times around would be a real test of men and machines.

As Gus came back by the grandstand a barrel-chested rider drove off. "That's Juke Crutchly," somebody said. "A tough cookie—he'll show these boys some tricks!"

Crutchly, warming his engine, was riding slowly a little out from the rail. Zipp Temple

whizzed up behind him and couldn't resist showing off. He shot through the narrow hole, brushing Crutchly's shoulder. "Fool kid—asking for trouble!" Gus thought.

Crutchly took off after Zipp, following him closely around the course. The next time they passed they were riding side by side. Crutchly shouted something at Zipp. As they went into the turn Juke hunched his shoulder, and Zipp crashed the fence.

When Gus got there a small crowd had gathered around Zipp. He was on his feet but his face was chalky. Bill Dunlap rode up with Doc Marvin in his sidecar. After a swift examination Doc motioned Dunlap and Gus aside. "The kid isn't hurt, but he's lost his nerve. He shouldn't race—and he won't do you any good if he does."

"There goes the championship!" Dunlap growled.

Tom Dorsey, who'd won the trials, stepped out of the crowd swinging his left arm experimentally. "My shoulder's okay now," he said quietly, "but my bike's got a bent frame. If Zipp will lend me his, I'd like to ride for us."

Gus was checking Zipp's cycle. It hadn't been damaged. Dunlap went over to Zipp, who was lighting a cigarette with excessive nonchalance. "All right, you ride," Dunlap told Dorsey after a nod from Zipp.

Crutchly, smiling unpleasantly, had been watching the scene. He wheeled over to Gus. "Tell this kid to keep clear of me, pop," he advised. "You saw what happened to your boy friend. I might give this one a bigger dose of the same!"

Gus looked at him, his face granite. "I was racing when you were floating chips down the gutter," he said grimly. "If you pull anything, you'll have me to deal with."

THE shadow of the grandstand lay black on the track. Motors crescendoed to a roar as the half dozen riders remaining in the race slewed onto the track, with Crutchly in front. Fifty yards behind the pack came Dorsey, well satisfied to be there. With only a lap to go, he had almost a full-lap lead.

"He'll hold what he has!" Gus thought.

And then, just as Tom was slowing for the turn, his engine stopped dead!

Acme rooters groaned. Gus ran. His wind was gone long before he got to where Dorsey was working frantically over his engine. "Wha-what is it?" he gasped.

"Must be ignition," Tom told him. "She quit cold. Got plenty of gas."

There was no time for careful trouble-shooting. Already the pack was out of the dry creek and highballing over the rolling hills. Gus swiftly examined the high-tension wiring—no loose connections, no broken wires. He snapped off the distributor cap, quickly checked the rotor and its contact, and ran a practiced eye over the points, breaker arm, and spring. On a hunch, and dishearteningly aware what a long shot it was, he hooked a finger under the little wire leading to the points. "Got it," he yelled.

On the underside of the pigtail loop a tiny spot of bare copper gleamed where the insulation had worn through, shorting the low-voltage ignition circuit.

Tom's quick fingers brought a roll of tape from the toolbox. Gus speedily wrapped the wire, and replaced the rotor and cap.

As Tom kicked the motor over, Crutchly flashed past, with the other riders a few lengths behind. Gus, running back toward the finish line, saw that Tom was fifty yards behind the tail-ender. But he was going!

Tom bumped down the steep grade to the river bed. Sand clawed at his wheels as he dodged the rocks. The rider just ahead of him went down in a spray of dirt; on the steep path up out of the gulley he passed another one. Now they were all racing over the succession of hills and dips; on the crests their machines left the ground and came down with bone-racking jars.

Foot by hard-won foot Tom crept up. He passed two more riders. When they went into the deep sand turn onto the track his front wheel was lapped on the leader's rear one; when they thundered out of the dust cloud they were even. As they straightened out he was on the rail and Crutchly was six feet out from it.

But Crutchly wasn't beaten. Down the stretch, their engines deafening, he again drove into the lead. A foot. Two feet!

Now Tom Dorsey used the little throttle he'd kept in reserve. He twisted the hand grip full open. Crutchly started to edge over toward the rail. Yelling he didn't know what, Gus watched the gap narrow.

And it narrowed more sharply still! Dorsey edged deliberately toward the bigger rider, taking the bluff away from him. For a split second Crutchly hesitated to take the dare. That was enough. Hugging the rail, Tom drove his front wheel even with his rival's, then inches ahead.

The checkered flag flashed down as he roared over the finish line.

New Soft Tires Absorb the Bumps

Here's what to think about if you're planning to put them on your old car.

By R. P. Stevenson

IF YOU remember putting 60 lb. of air into the tires of an old Model T, it may seem surprising that a pressure of 24 lb. can support a modern car. But it does in the new soft tires. The result is the smoothest ride you've ever had.

First announced less than two years ago, low-pressure tires are now original equipment on many new cars. At present, they're a luxury, but growing production should scale down the price.

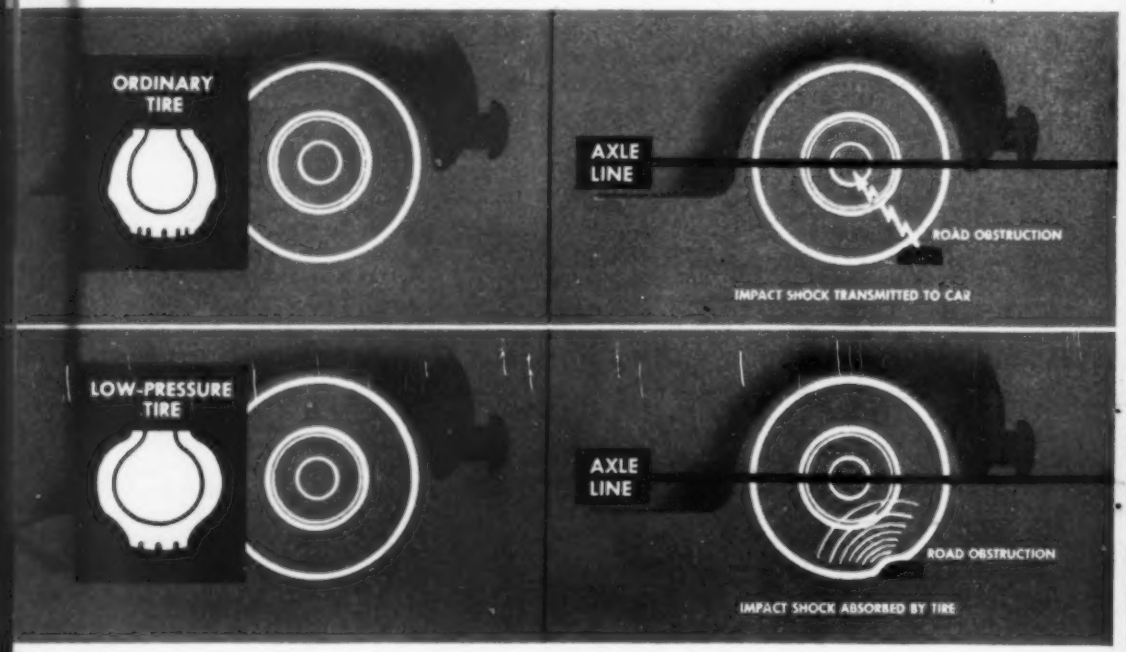
It should be noted that these are not the oversize tires sometimes used in the past for better cushioning. Such tires were just a larger size of the ordinary type. They were never fully satisfactory because of such disadvantages as hard steering, irregular wear, and excessive unsprung weight.

The new tires were designed and engineered specifically for a greater volume of air at lower pressure. In cross section, they are wider and a little higher than the corresponding old sizes they replace. From the side, they look much the same.

In addition to a softer, smoother ride, advantages claimed for them include better traction, greater safety, more positive steering, cooler running, less road noise, and—surprisingly enough—slightly better mileage. How they envelop a road obstruction is illustrated in exaggerated form below.

You can use the new tires on an old car, but here's a warning: You'll get some, but possibly not all their advantages. Some tire engineers contend you'll get full benefit only by mounting them on wider rims. Present rims may pull in the designed width of the tire, reducing the air volume and consequently the cushioning effect.

On older cars, the cost of installing new wheels would be considerable, leaving little alternative to using your present rims.



Before planking down the cash, however, make certain the tires have adequate clearance. In extreme cases, you may find that rear ones rub against the metal of the wheelhouse. Clearance also may be so slight that you can't use chains. The front tires may touch the fender or frame on short turns. It's also worth checking whether your present spare-tire carrier will accommodate the greater bulk.

If you wish, you can start with just two of the tires. But install both of them either at the front or at the rear, not one in front and one at the rear. The best choice appears to be to mount them at the front. Car stability is apt to be reduced if they're put on the rear only.

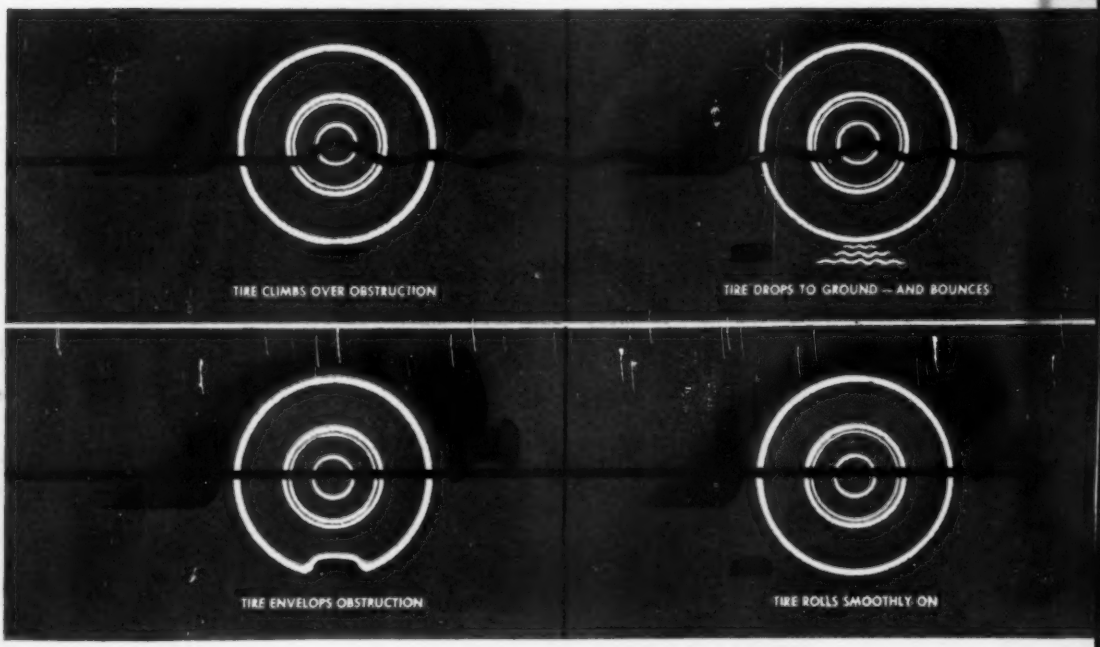
A change to the new tires will have a few adverse effects. Acceleration will be slower because the larger tires increase the circumference of each wheel. (Incidentally, this may throw off the speedometer.) Since the tire is softer, its footprint is longer. This greater area in contact with the road improves traction, but you'll have to exert more steering effort while parking. In at least one case, the footprint area has been kept down by making the tread narrower.

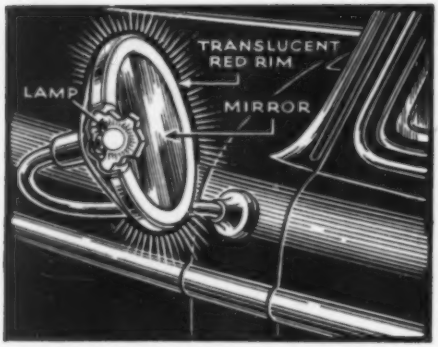
The old admonition to keep your tires properly inflated has never been more important. Since the recommended pressure for the new tires is lower, two or three pounds difference amounts to a greater percentage than at conventional pressures.

When the tires are used as replacements, pressure recommendations may vary either way from 24 lb., depending on the make, model, and year of the car—and of course the size of the tire. Therefore, in buying a replacement set, be sure the dealer has authorized pressure recommendations to suit your case.

One large tire manufacturer is now cautioning service-station operators to be on the lookout for the new tires and not overinflate them unwittingly. Until this campaign has had time to take effect, you'll have to shoulder the responsibility of seeing that someone doesn't run wild with an air hose.

Size designations adopted for the new tires show the true cross-section measurement—the distance from side to side when the tire's inflated. For instance, 7.60 means exactly that—7.60″. On the other hand, the corresponding tire that it replaces, a 6.50, actually measures 6.80″. The latter discrepancy is found throughout the old size range. In general, the new tires take standard lightweight tubes one size larger than the tires they replace. END





Red Light Encircles Mirror

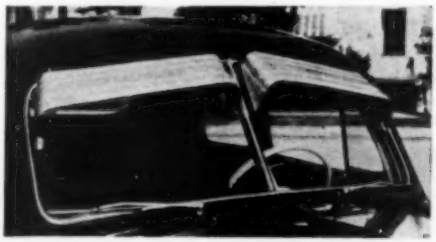
INSTALLED on the side of your car, this new rear-view mirror serves also as a parking and rear warning light. The mirror is mounted in a circle of red plastic. When a bulb inside is switched on, the plastic rim becomes visible to drivers approaching from behind. It's offered by Jay Distributing Co., Detroit, and sells for about $7.

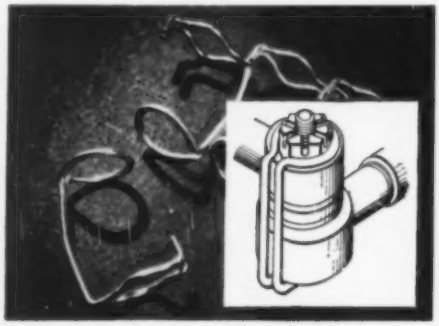
Cooler Improves Your Ride

CAR coolers that work by evaporation have been popular for some time in the Southwest for desert driving. This one is a new design announced by Star Distributing & Manufacturing Co., Los Angeles. A different type of filter pad, treated with a chemical inhibitor, is said to assure clean fresh air at all times.

Suction Cups Support Visors

MADE of aluminum, these visors may be installed in about ten minutes. You mount them directly on the windshield with rubber suction cups, cement being applied to the edges of the cups. The visors are ribbed for strength and coated green underneath. Priced at about $8, they are distributed by the Keene Jackson Co., Glendale, Calif.





Clamp Protects Tie Rod

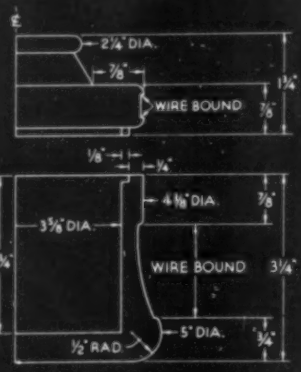
THESE steel wire clamps, designed to increase the safety factor of a steering gear, keep a tie rod or drag link from dropping off even if the ball-and-socket joint is dangerously worn. Priced at $1.50 a set, they are made by J. S. Snider, Clarksdale, Miss.

Creeper Has Adjustable Rest

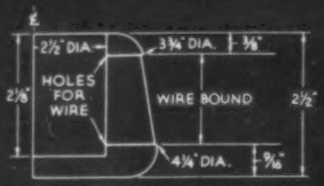
EVEN when you're at work under a car, you can easily adjust the cushioned head lift of this creeper to any of four positions. The cushion has an oilproof plastic cover. Priced at about $10, it's made by the Moto Parts Company, of Inglewood, Calif.

Mechanics and Handicraft

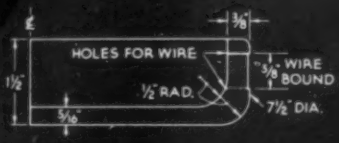
Music for driving, music for picnicking. This auto radio lifts out, behaves like a portable. Page 194.



Fine copper wire was bound around this gumwood cigarette container.



Twisted wire contrasts with dark wood in a plant holder.



Strands of aluminum add luster and extra richness to this simple nut dish.

Wire Enriches Lathe Projects

Aluminum, copper, or brass bindings add color, contrast, and sparkle to three fine wood turnings.

METAL can add luster and sparkle to the dull gleam of fine wood. As instances, these three lathe projects are strikingly enhanced by simple wire windings.

Since wire is obtainable in a variety of metals and gauges, you'll find it easy to select types which contrast pleasingly with the wood. Aluminum wire looks well with maple, copper with walnut, and brass with mahogany. On articles of contrasting woods, you can use different wires, placing each against the wood which best suits it.

Two wires twisted together will give you a nice effect, as shown in the photo of the plant holder on the opposite page. Use an electric drill, or even a hand drill, and a vise. Place two ends of the wires in the vise and the other two in the chuck. Pull until the wires are taut and start the motor. The tightness of the twist depends on how long you run the motor. Keep your face well away, for the wire may snap back if it breaks.

To make the pieces shown on the opposite page, first turn them on the lathe, recessing them at the points you will wrap with wire. Drill small holes at the start and finish of the winding that is to be applied.

Insert an end of the wire in a hole and bend it over inside. Pull it tight and wind it on by hand while the work is in the lathe. At the end of the winding, insert the wire in the second hole and again bend it over. Small escutcheon pins may be used to hold the wire instead of holes.

Here are suggestions you may find helpful in decorating with wire:

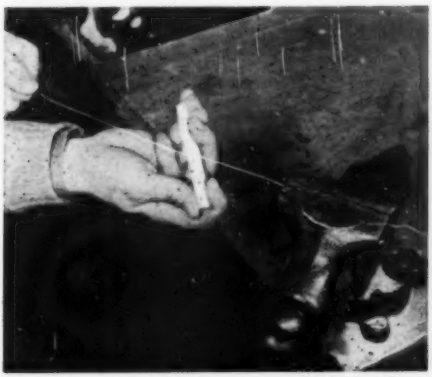
Use a wire that is easy to handle—not too heavy, and without any spring in it. The gauge should be in proportion to the size of the article.

For an impressive two-tone effect, wind with a plated wire. Buff the wire to cut through the plating after winding it on.

To remove kinks from wire, pass one end of it through a small hole in a hardwood dowel. Lock this end of the wire in a vise. By holding the wire taut as the dowel is pulled along it, kinks are smoothed out.

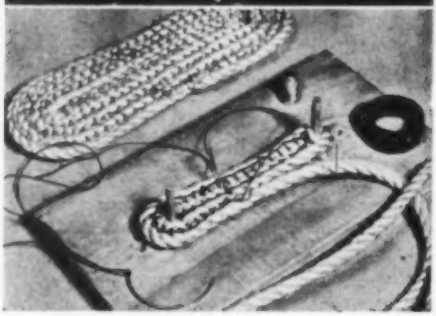
Wire may also be straightened by placing one end of the wire in a vise and the other in the chuck of a hand drill. Stretch the wire and then repeatedly snap the handle of the drill back and forth through a half turn.

Do all sanding before winding wire, to keep dust out of it. Coat wire with clear lacquer.—*R. J. De Cristoforo, Bronx, N. Y.*

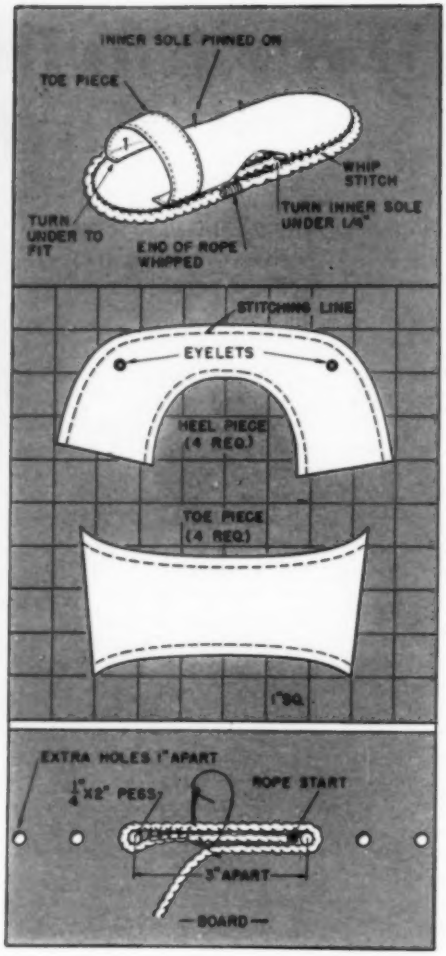


Use a hardwood dowel, a vise, and a little elbow grease to quickly remove kinks and bends in wire.

Twist two wires together with a drill motor and a vise. A hand drill or even a brace will also do.



A pegged board like this is used in Spain to fashion durable sandals of rope and canvas.



Spanish Sandals for Beach or Boat

GIVEN enough rope—about 12′ of it—you can make a pair of rope-soled sandals that are fine for beach wear.

Here's what you need: ½″ Manila rope, strong thread, a 3″ curved upholstery needle, ¼ yd. of canvas, shoestrings, and a board drilled to take 2″ pegs. The size of the sole is governed by the distance between pegs.

To start a sandal, put an end of the rope against the heel peg. Loop it around the toe peg. Then use a blanket stitch or a whip stitch to sew the rope together. Wind the rope around and around the pegs, sewing each turn fast, until the sole is the proper size. To finish, firmly whip the end of the rope inside the instep.

Cut four heel and four toe pieces. Stitch two of each kind together, leaving the ends open, to make double-thickness toe and heel pieces for each sandal. Then turn the sewed pieces inside out. That will place the rough edges inside.

Cut two canvas or cloth inner soles shaped like the rope soles but ¼″ larger all around. For more comfort, you can add an extra layer of canvas or felt between the rope and inner soles. Lay the inner soles over the stitched side of the rope soles. Turn the ¼″ edges under and pin them down. Then sew them down all around. Place the wearer's foot on the sandal to see where the heel and toe pieces go. Turn under at the ends for a snug fit.—*Doris Aller, San Francisco.*

What's Your Ingenuity Quotient?

Ice cream for eight was a muscle-bending chore until I was electrified by an idea. Now I let the electric drill supply elbow grease for turning our big freezer. Unscrewing the crank, I tighten the drill chuck on the shaft. When the drill slows down, the cream is made and is left to set hard. —*Bill Lipscomb, Shelby, N. C.*

You have to get up early to scare birds off fruit. Not to lose sleep, I let my chickens do it. I hung cans to a string and dropped a cord from this to a board in the chicken run. Chickens, like birds, are up early for breakfast. As they step out onto the pivoted board, they clank away the marauders.—*J. R. Parsons, Los Angeles.*

I can keep cool with a breeze on my brow, but our typist can't bear "that terrible draft." She wanted zephyrs around but not on her. No matter how the oscillating fan was set, one of us was hot under the collar until I mounted it at an angle. Now its blast fans me, but goes right over her permanent.—*John Rynal, Manhattan, N. Y.*

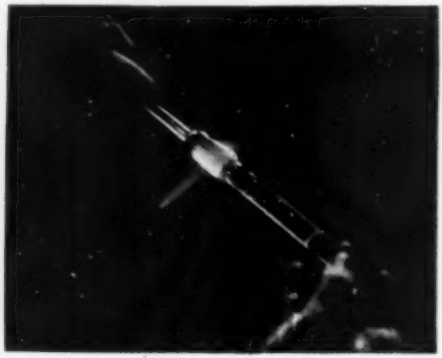
It's in the bag. All the suitcases we could squeeze into our trunk compartment left us with waste space and unpacked duds. So I stuffed the stuff into plastic pillow covers that zip up at one end. They fitted anywhere, kept things clean and dry, were easily washed, and showed at a glance what was inside.—*Polly O. Simms, Ceres, Calif.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.

On parade here are some of the strange little animals that the di Renzo brothers create in their Brooklyn shop. Made of clear glass, the novelties are decorated with tinted lacquers.

Cocktail drinkers should take a second look at the modeled heads on these stirring rods. Viewed from some angles, the elephant head at the right is green; from others, it is pink.

1. This is how the giraffe at the top of the page was produced. As the first step, the ends of two Pyrex ® rods are softened in an oxygen-gas flame at a temperature of 3,500 deg. F.



2. As the rods fuse, steady rotation causes the softened glass to ball up. The body is now shaped from this thickened area by stretching, compressing, and bending it as required.

5. Ears and a nose are applied by fusing the ends of small glass rods to the head at the appropriate spots, stretching them out, and then heating and pulling away the surplus.

6. Legs are added in the same way—by fusing thin rods to the body. The bottoms of the feet are flattened and leveled by heating and then pressing them against an iron plate.

Flame Shapes a Glass Menagerie

Craftsmen mold fanciful birds and beasts in a blowpipe jet. You can try it yourself with a Bunsen burner.

By Kenneth M. Swezey

PS Photos by W. W. Morris

IN A LITTLE shop in Brooklyn, N. Y., the di Renzo brothers, Guy and Angelo, carry on one of the most unusual crafts in the United States. They create whimsical miniature animals, tipsy humans, merry-go-rounds, ships, angels, and devils—all from white-hot Pyrex ® rods. With skilled hands and eyes, they model this heat-softened tempered glass almost as easily as if it were clay.

Although blown glass objects have long been produced in this country, the di Renzos were among the first here to model art novelties from solid glass. Until the beginning of the recent war, such novelties came almost entirely from Germany and Czechoslovakia. When importations stopped, the di Renzos were invited to learn the art from a German refugee.

Neither had any art training. At first the going was tough. By the end of the first week's training, Angelo had managed to

3. Next comes the neck. This is formed from the part of the heavy rod not needed for the body. Softened, this is drawn to the desired length. The short rod serves as a handle.

4. A head is created by rotating the end of the neck in the hot flame. Again, the softened glass rolls up in a ball. Careful manipulation brings it to the desired shape and size.

7. A tail comes last. This is quickly done by heating, stretching, and pulling off the rod that has served as a handle. A pair of tweezers holds the head of the giraffe during this step.

8. Paint completes the job. Long experience and considerable artistic ability are needed for such projects. For some simple projects with ordinary soft glass, turn the page.

turn out just a dollar's worth of unspoiled work. The brothers learned fast, however, and during the war they helped train workers to make radio and radar tubes. The war over, they set up their own shop. Their output is now sold in shops all over the country.

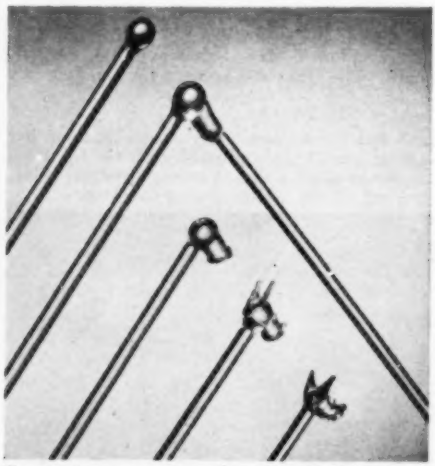
The photos on the two preceding pages illustrate how they produce their novelties. Months of experience and considerable artistic ability would be required to duplicate their work. Also, a temperature of 3,500 deg. F. is needed to melt Pyrex.

If you'd like to try your skill at this art, however, you can use ordinary glass stirring rods and a Bunsen burner. This glass is soft enough to melt readily in a Bunsen flame. It should not be too difficult to model simple figures on the ends of such rods. As a starter, why not try the dog's head illustrated below? END

You can make a dog's head from ordinary soft glass rods. A Bunsen burner gives enough heat to melt this glass. Rotate two of these rods in the flame until a ball forms on each.

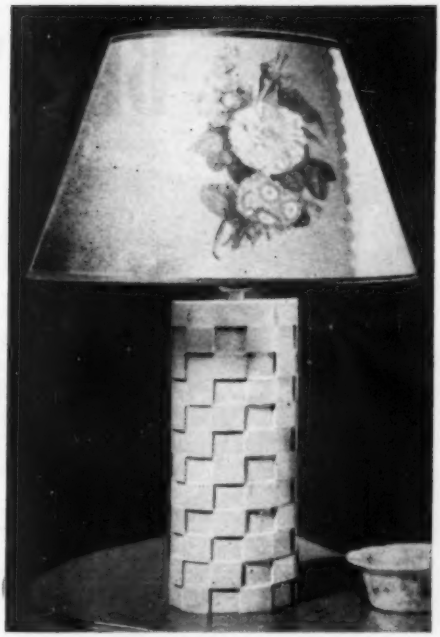
Fuse the balls together at approximately right angles. Let the left one cool, but keep heat under the other. Pull on the latter to form a nose. Heat at the proper point and pull off.

Flatten the nose by heating the end and pressing against a metal object (here it's a pair of tweezers). For ears, eyes, and tip of the nose fuse on small rods and draw them out.



Successive stages in making the dog's head are seen here from top to bottom. Paint the eyes and ears with colored lacquer. Make several and you have a novel set of stirring rods.

Lamp is "Carved" on Jigsaw

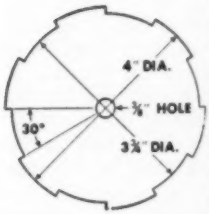


WHILE this lamp appears to have been carved from a single block of wood, it actually was cut from scrap stock with a jigsaw. The only materials cost was for electrical parts.

From any kind of ¾" wood, saw, turn, or cut with a circle cutter 12 disks 4" in diameter. Jigsaw six cutouts on the circumference of each as detailed in the drawing. Drill a ⅜" hole in the center of each piece. Then glue the pieces together in a stack so that the cutouts of each are aligned above the projections of the disk below. To prevent rotation of the pieces in relation to one another, drive nails through the underside of each into the disk above.

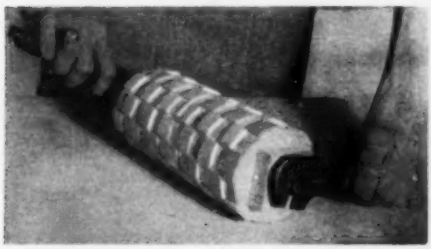
Apply extra pressure while the glue is setting by slipping the assembly on a metal rod or ½" pipe and tightening nuts on each end. It is a good idea to fit protecting blocks of wood between the work and the nuts.

For wiring, drill a horizontal hole in the bottom disk to meet the center hole running through the disks. Press a ½" pipe nipple into the hole in the top disk for a socket.—*Bertram Brownold, Cedarhurst, N. Y.*

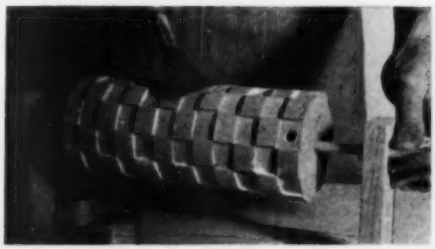


Make six cutouts in the circumference of each disk. Drill ⅜" hole in center of each piece.

A piece of pipe will hold the pieces while glue is applied. Note nails to prevent disks rotating.



Tightening nuts on ends of the pipe will hold the pieces firmly in position while glue sets.



This holding jig is convenient if the lamp is to be painted. Hole at right end is for wire.

Bicycle Boat Built for Two

An interesting project to make, this sturdy pontoon craft is fine for fun or fishing

By L. W. Schaper

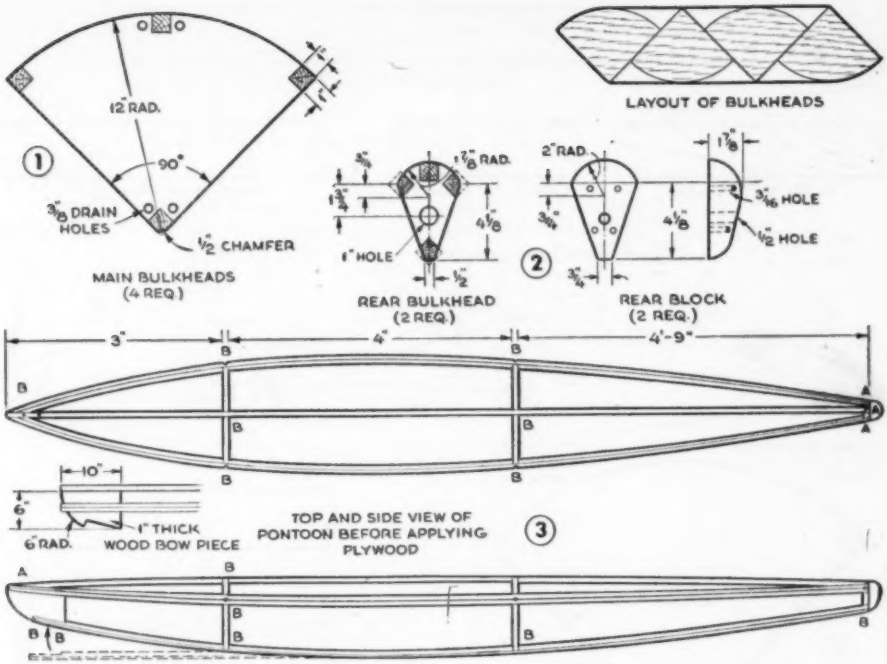
FOR these long, lazy Summer afternoons, here's an ideal boat for loafing. You have your choice of power for it—pedals driving a paddle wheel or propeller, or an electric or outboard motor.

The pontoons, most important part of the craft, may be covered with .020″ or .032″ aluminum or with plywood. I used ⅛″ water-proof plywood on the one I built. Three 4′ by 8′ sheets are enough.

For frames, use eight 12′ lengths of 1″ by 1″ white pine, and about 8′ of 1″ by 12″ pine for bulkheads. The rear blocks are shaped from a piece of two-by-four. Figure 2 gives you the rear block and bulkhead dimensions and hole locations.

Lay out the four main bulkheads on the 1″ board as indicated above Fig. 2. At this point, drill the ¾″ holes in the bulkheads as in Fig. 1. These holes are for drainage if the pontoons should leak. By resting the boat across a dock and raising the front, the water will drain through the 1″ hole in the rear bulkhead and the ½″ hole in the rear

Each pontoon had a rudder at time of this photo. Single rudder was installed later.



block. Taper the latter hole with a round file and use a cork as a plug. A screw in the cork will make it easier to remove.

I neglected to drill drains in my boat. Later, I had to cut ports in the top of each pontoon section and siphon out the water.

Your next step is to drill screw holes through the 1" by 1" frames where they join the bulkheads and bow piece. Countersink all screws. The screw heads must be well sunk in the side and bottom frames at the bow and stern. At these points the frame pieces are planed down to a flat surface for the plywood covering.

Roomy seat easily carries two or three persons.

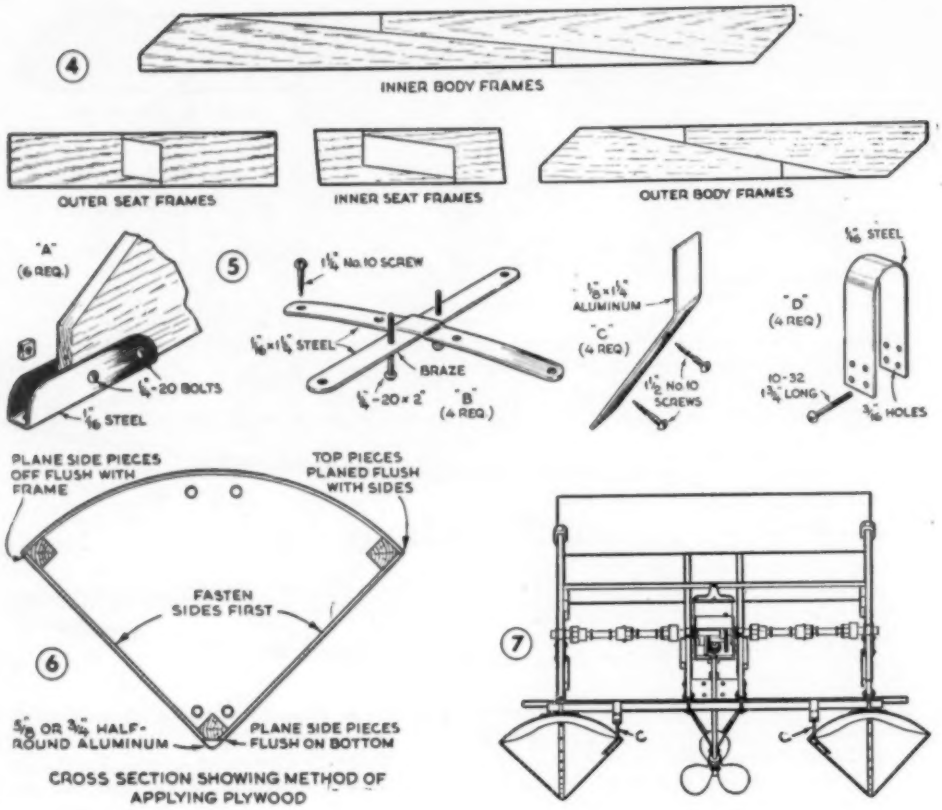
Cut the bow piece as in Fig. 3 and trim the bottom frame to fit it. Trim the side frame pieces to fit flatly against the bow piece. If you think the three frame members at the bow won't go into place without cracking, steam or soak them in hot water until they are more pliable. Hold the side frames against the bow piece and mark the parts to be planed off to make them lie flat.

In assembling the pontoon frames, use the right screws—1¼" No. 10 flatheads at A and 2¼" No. 10 flatheads at B, Fig. 3.

The plywood is put on the frame of each pontoon in nine pieces—three on the top and three on each side. Cut the plywood so the bow and stern sections join the center section at the middle of the 1" thick main bulkheads. This leave a ½" edge of plywood on each section for screws.

Make paper or cardboard patterns of each section before cutting the plywood. That will insure getting all the needed pieces out of the three plywood sheets. Or, if you prefer, lay the frame on the plywood and mark it.

To fasten the plywood to the frames, you'll need waterproof glue, about two gross of



⅝" No. 6 flathead brass wood screws, and some unbleached muslin.

On the center sections and the parts of the other sections where the curve of the frame is not too severe, the screws may be spaced 5" to 6" apart. Where the curve is sharper, spot the screws 3" to 4" apart. Lay out the holes first and drill and countersink them.

Cut the muslin into 1" wide strips. Glue the strips to the edges of the frame where the plywood will be applied. Spread another coat of glue over the muslin. Then place a section of plywood on the frame, screwing it down firmly. Fig. 6 shows you the method of fastening the plywood and where to trim off overhanging edges.

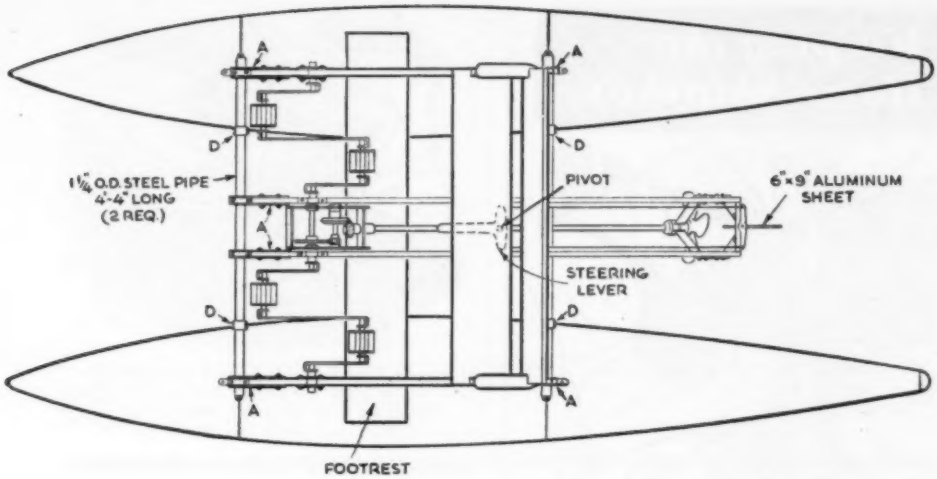
Cover the sides of the frame first. A couple of coats of paint, lacquer, or enamel should be applied on the inside of the pontoons. The top is put on in the same way as the sides.

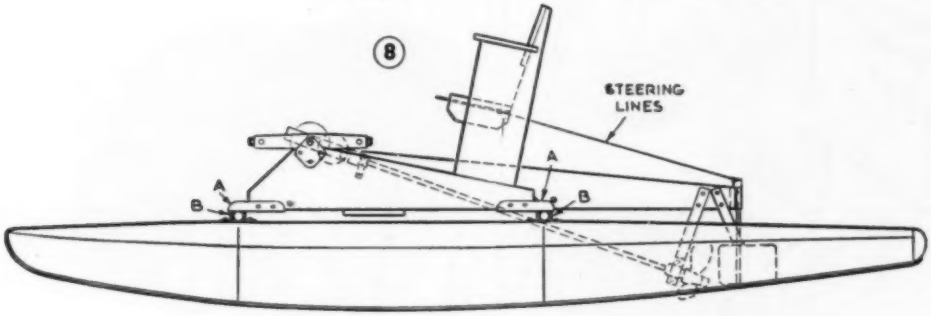
After the pontoons are covered and the glue has set, attach the rear blocks. Fill all seams or rough spots with composition wood. Sand the entire job and cover with marine paint.

If you have difficulty bending the plywood on the few sections where the curve is severe, borrow your wife's electric iron. Pass the heated iron over the plywood a few times. The heat will make it easier to form a sharp curve.

After the paint has dried, fasten a ⅝" or ¾" half-round strip of aluminum along the bottom of each pontoon. Form the strip all the way around the bow piece. Put the first screw into the top 1" by 1" frame member. Put the last screw into the rear block. Use 1" No. 6 flathead wood screws countersunk.

Cut the body frames and seat parts as shown in Fig. 4 from ¾" by 10" pine. The body frames taper from 3" to the width of the stock. Inner ones are 6' long, outer 3' 9". Fasten the parts together with flathead wood screws. The footrest, Fig. 8, also is





cut from pine—it's ¾" by 10" by 5'. Attach it to the bottom edges of the body frame by screws.

No dimensions for the seat are given. They'll depend on the size of the riders, who should be able to reach the pedals comfortably.

There are several methods of attaching the body of the boat to the pontoons. You may want to use the one given here or, perhaps, devise your own. In Fig. 5, A is a steel channel used to tie the frame to the pontoons. In the same figure, B is attached directly over the main pontoon bulkheads. The screws of B go into the top 1" by 1" frame and the bulkhead. The bolts of B run through holes in A, straddling the pipe crosspiece, which is clamped between A and B.

The stabilizing connectors, C in Fig. 5 and 7, are screwed into place directly over the joint in the plywood. The screws go into the main bulkheads. C is connected to the brace pipes by use of D. These fittings hold the pontoons rigid. The entire body of the boat rests on the two pipes shown in Fig. 8.

The gears may be bought, or if you want to simplify the machine work, it is possible to use a large breast drill as the gear transmission.

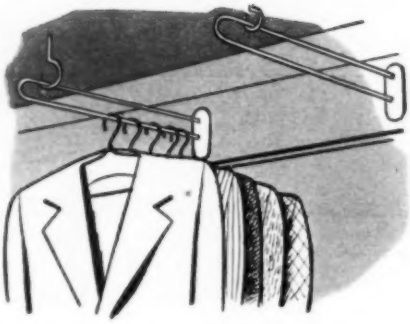
If you want to eliminate the gears and the 10" to 14" propeller, a suitable mount for a small outboard motor may be built on the rear of the seat. Or, to simplify the driving machinery, you could use pedals but substitute a chain drive and a paddle wheel for the shaft and propeller. An auto generator powered by a storage battery could also be used to drive the propeller (PS, June, '47, p. 185).

For its size, the boat is light in weight. Using plywood as pontoon covering, my boat weighed about 230 lb. The pontoons scaled about 40 lb. each and the frame about 150 lb. An advantage of the metal parts I used to join pontoons and body is that the pontoons may easily be detached from the frame for winter storage. END

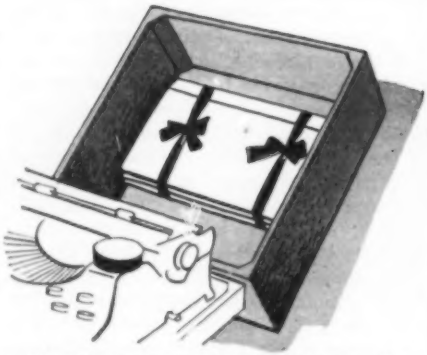
Keeping the Home Shipshape

Waste linoleum cut into pieces of uniform size may be fitted together to cover small or odd-shaped areas. If the linoleum has a pattern, cut squares or rectangles to suit.

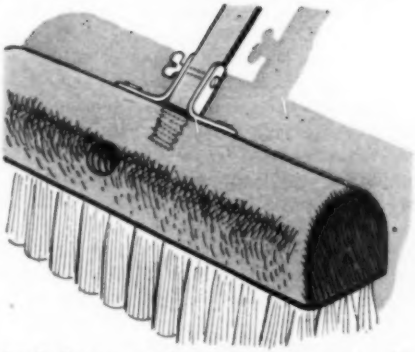
If paper sticks to a polished wood surface, drop on a little olive oil. When the paper is soaked, it will peel off without damage to the finish. Just wipe off excess oil.



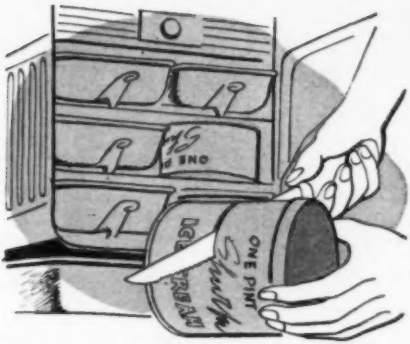
Some closets are so shallow that you can't hang clothes on a pole extended from side to side. In such cases, metal towel racks supported by a hook are a good solution.



A file folder cemented inside the top of a portable typewriter case will keep writing supplies handy. Glue ribbons to the folder, leaving the ends long enough to tie.



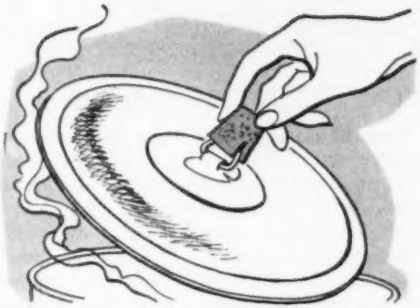
Angle braces reinforce a push-broom handle where it's weakest and hold it in despite worn threads. Use wood screws in the brush head. Drill the handle for a bolt and wing nut.



Ice cream packaged in pint cartons can be quickly stored by cutting the carton in half. Put wax paper on the open ends. Each part will then fit in the freezing compartment.

When you're on a picnic, milk-bottle caps can be put to use. Flatten them out and you have neat little plates for individual servings. Use them as coasters too.

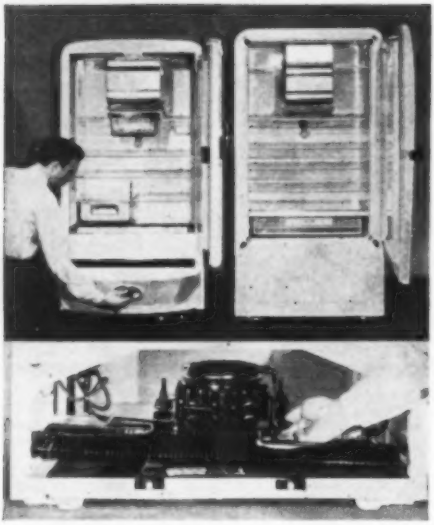
A handy small scoop for use in the kitchen can be shaped from an inexpensive teaspoon. Bend up the sides, leaving a narrow opening at the front, and loop the handle downward.



Pot covers are a frequent source of burns. You can lift them with ease, however, if the metal ring is equipped with a cork in this manner. Slit the cork about half way.

Rubber boats of the type obtainable as war surplus make fine wading pools for small children. Without the water, the boat also can be used as a pen for a baby too small to get out.

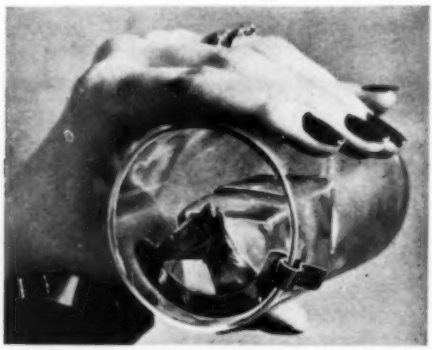
AIDS TO MODERN LIVING



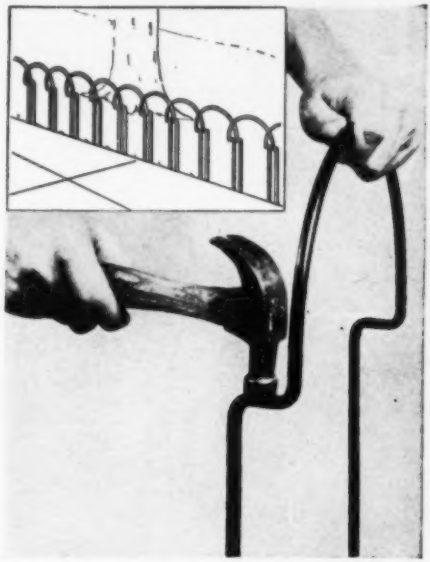
New Refrigerator Saves Space. In the new Frigidaire Ⓣ, nearly two cubic feet of refrigerated space has been added without materially increasing the overall size. At the left above is last year's seven-cubic-foot model, at the right the new nine-cubic-footer. Most of the added space was gained by redesigning the compressor and condenser as a flatter unit—shown in the lower photo. The new models have a full-width vegetable compartment.

Bathroom Convenience. This bathroom fixture is marketed by the House of Hospitality, North Hollywood, Calif. Recessed between two studs, it measures 12" by 17¾" inside. Separate compartments hold books, magazines, newspapers, cigarettes, matches, ash tray, toilet tissue, and other articles. Made of steel, it is enameled in a choice of six colors to harmonize with various bathrooms. The price is about $17.

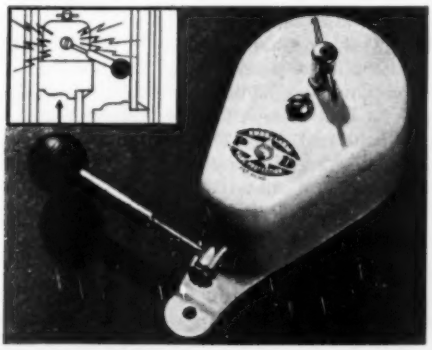
Sharpener Points Three Ways. By turning the indicator cap, you have a choice of three points with this pencil sharpener—standard, long-lead blunt, or long-lead sharp. The hollow-ground blades are readily replaceable, and the cap twists off for emptying. Triple "E" Products, St. Louis, Mo., makes it of Bakelite Ⓣ in several colors.



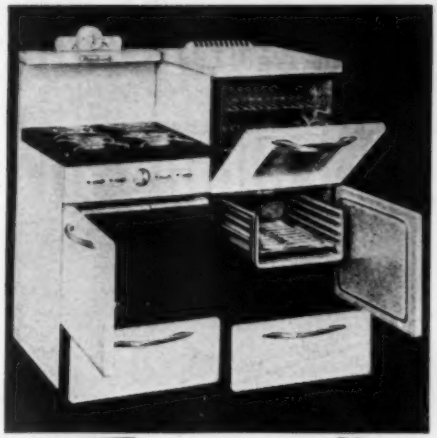
Clip Holds Back Ice. In the January issue of POPULAR SCIENCE (p. 112), Mrs. W. S. Wilbur wrote that she would "like to see them make" drinking glasses with ice guards. Such a device is now on the market. Made of plastic by the Sel-Gold Novelty Co., Arverne, N. Y., it clips to the glass, as above, to keep the ice in place.



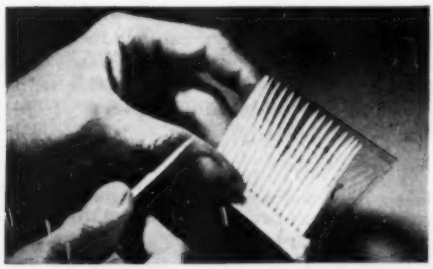
Wickets Form Lawn Fence. Decorative fencing for your lawn or flower beds may be quickly provided with individual wickets now available. Made of ¼″ steel rod, enameled green, the wickets are 12″ wide and 20½″ high. They are driven or thrust into the ground as you would a croquet wicket. A carton of 24 will make a fence 24′ long. The fencing is a product of the Stikit-Wikit Co., Washington, D. C.



Alarm Warns of Intruder. Operated like a spring-wound alarm clock, this device sounds a warning if a door or window is opened. The alarm remains silent as long as the bumper arm remains at right angles as in the photo. If a door or window moves the arm, the bell rings. R. E. Robertson and Co., Chicago, makes the alarm.



Cook Standing Up. A gas range produced by the Hardwick Stove Co., of Cleveland, Ohio, keeps cooking operations at a convenient height. The oven is located at the right of the open burners, the broiler below the oven. All the space below is for storage. The oven has a transparent door. By snapping on an interior light, you can check up on your baking. When the oven is dark, the glass serves as a mirror. There is also a light under the clock shelf.



Toothpicks Made of Plastic. Packaged in a handy pocket case, these plastic toothpicks are said to stimulate the gums as well as clean the teeth. Individual picks are removed from the plastic base like a match. They are made in two textures, hard and regular. Lactona Incorporated, St. Paul, Minn., is the manufacturer.

Water Can Shaped of Gleaming Brass

By Bill Luther

BESIDES being decorative, this little water can is useful. It's just the thing for watering potted plants indoors. But if you don't want to devote it to such a utilitarian purpose, you can plant it with ivy or simply keep it as a shelf ornament.

The body and bottom are 20-gauge brass. For the body, cut a piece 3″ by 13½″ and form the curved ends around a 2″ pipe or rod. Overlap the ends ¼″ and sweat-solder them together. Then trace around the inside of the body on another sheet of brass. Cut out this oval, flatten it on a metal plate with a mallet, and solder it in place ¼″ from the edge of the body.

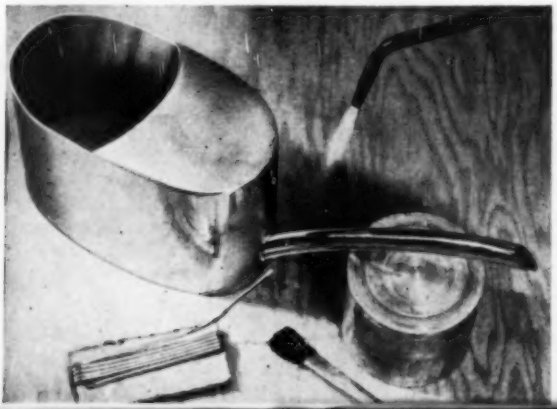
Cut the hood to approximate size from 22-gauge copper. Then anneal it. On the under side draw several pencil lines ¼″ apart following the contour of the curved edge. While holding the copper on a lead block, turn up the edge with a ball-peen hammer. Use the pencil lines as guides to space the blows evenly.

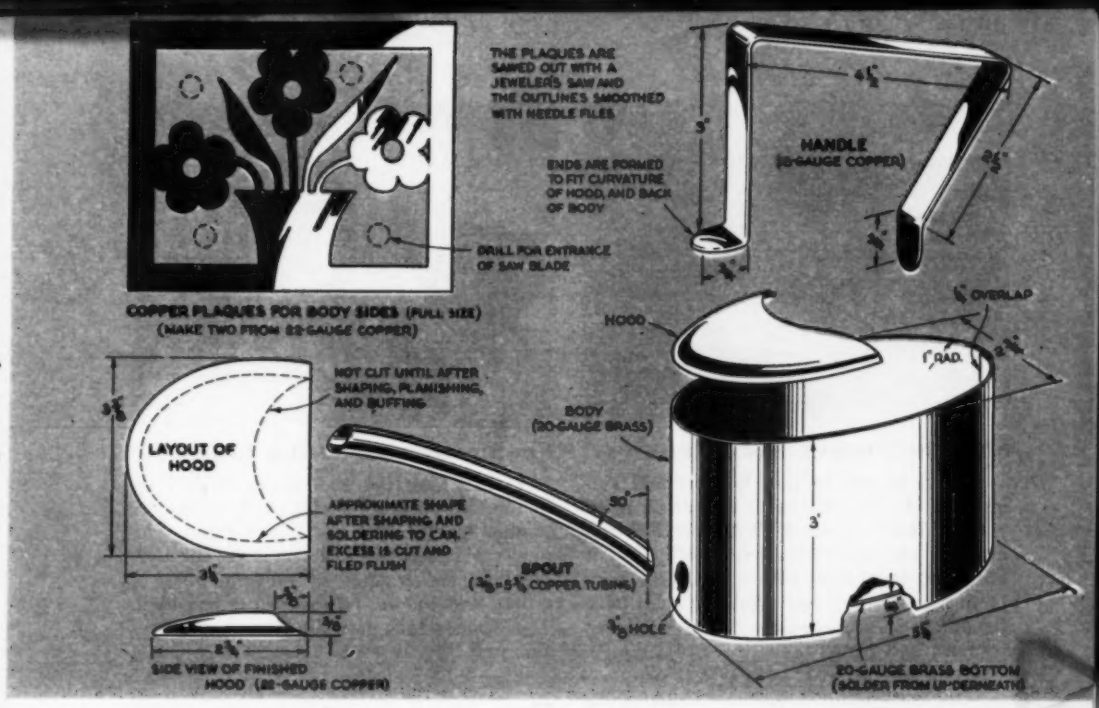
After annealing again, place it over a metalworking stake clamped in a vise and planish out the peen marks. Use a smooth-faced planishing hammer and light, glancing blows. If a stake isn't available, you can round the end of a 1½″ rod or shaft. When the planishing is completed, cut the inside curve and buff out any tool marks.

Next, tin the under edge of the hood

Shape the hood with a ball-peen or forming hammer. Planish out tool marks (right below).

Support the spout like this for soldering. Use a minimum of solder and wipe off the excess.





and wire it to the body. Tiny notches filed in the edges of both pieces will keep the wires from slipping. Heat with a torch, adding solder from inside. Saw off the projecting edge and file flush with the body.

Now start up your buffing wheel and give the entire can a good going over. Don't be in too much of a rush. Skipping portions now will impair the final finish.

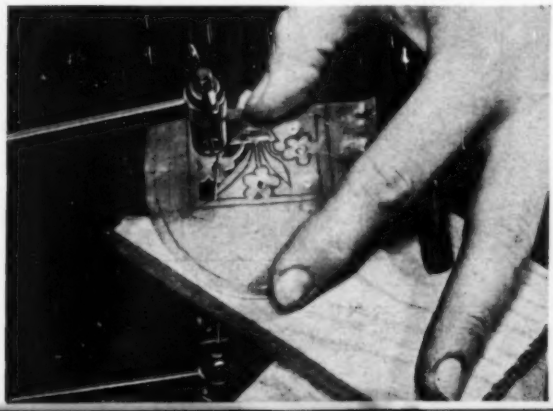
Drill the ⅜" hole for the spout so that it's centered and just touches the bottom. Cut the spout from ⅜" copper tubing, shape it, buff out all marks, and carefully fit and solder it in place. Use a minimum of solder, wiping off the excess with a small cloth wrapped on a matchstick.

Transfer the plaque design to 22-gauge copper with carbon paper. After filing the cut edges, tin the backs of the two plaques, apply flux, and bind them to the sides of the can, being careful to get them straight. Sweat-solder in place.

The handle is a ¾" by 11½" strip of 18-gauge copper. Form the ends to the curves of the body and hood. After tinning and fluxing these ends, bind the handle in position and sweat it on. To keep other soldered joints cool, pour about an inch of water in the can and place wet pads around the hood-body seam.

Buff the entire can thoroughly, clean it with a rag saturated with lacquer thinner, and then polish with a clean dry rag. As the final step, coat with clear lacquer. END

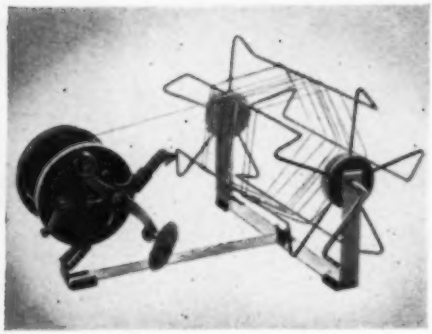
Cut the plaques with a jeweler's saw. A sheet of scrap was used for the one pictured here.



Sweat-solder the two plaques in place after tinning, fluxing, and binding them with wire.

Shingle Packet Aids Repairs

SMALL repairs to shingle roofs and sidings usually require you to buy much more material than is needed. With this difficulty in mind, the Portland Shingle Company, of Portland, Ore., now offers a package containing everything you need for small jobs. It contains 50 red cedar shingles, a packet of nails, and instructions.



Frame Dries Fishing Line

A METAL drying reel manufactured by Bonnie Products Co., of Los Angeles, accommodates 1,000 yards of fishing line. The steel cross members that compose the drying unit are treated to prevent rust. A simple seat for the fishing reel is provided. The drier, which is light enough to carry along on trips, is priced at about $2.

How Much Paint's in the Can?

WHEN you have finished a job and have some paint or enamel left, it is a good idea to paint a line on the outside of the can before sealing—at the level of the remaining paint. This will enable you to tell quickly how much is left and what color it is.—*Benj. Nielsen, Aurora, Nebr.*

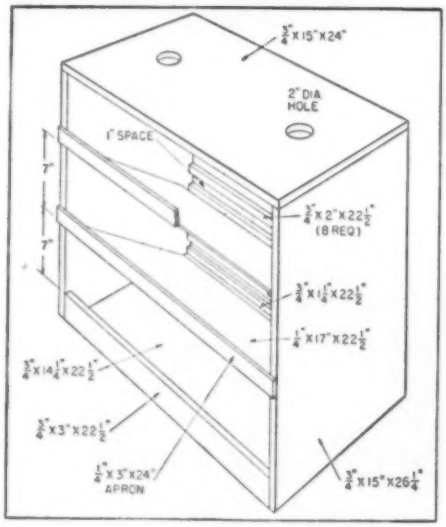
Small Kitchen Bin Stores Fruit and Vegetables

SEPARATE bags of onions, potatoes, oranges, and apples clutter up the cupboard shelves in many kitchens. A portable bin to accommodate all of them neatly will win you a big vote of thanks.

All parts except the two ¾″ by 17″ by 22½″ pieces for middle and upper shelves can be cut from a 3′ by 6′ panel of ¾″ plywood. Although the drawing calls for ¾″ stock in the two aprons, the large panel also will yield these if you wish.

Butt joints are used throughout, and the parts are assembled with glue and finishing nails, set and then filled. Narrow cleats support the two shelves. To give carrying hand holds, saw out two holes in the top. Sand the edges of these smooth.

When the bin is assembled and the nail holes filled, sand it and apply two coats of enamel that matches the kitchen trim.—*Norbert Engels, South Bend, Ind.*

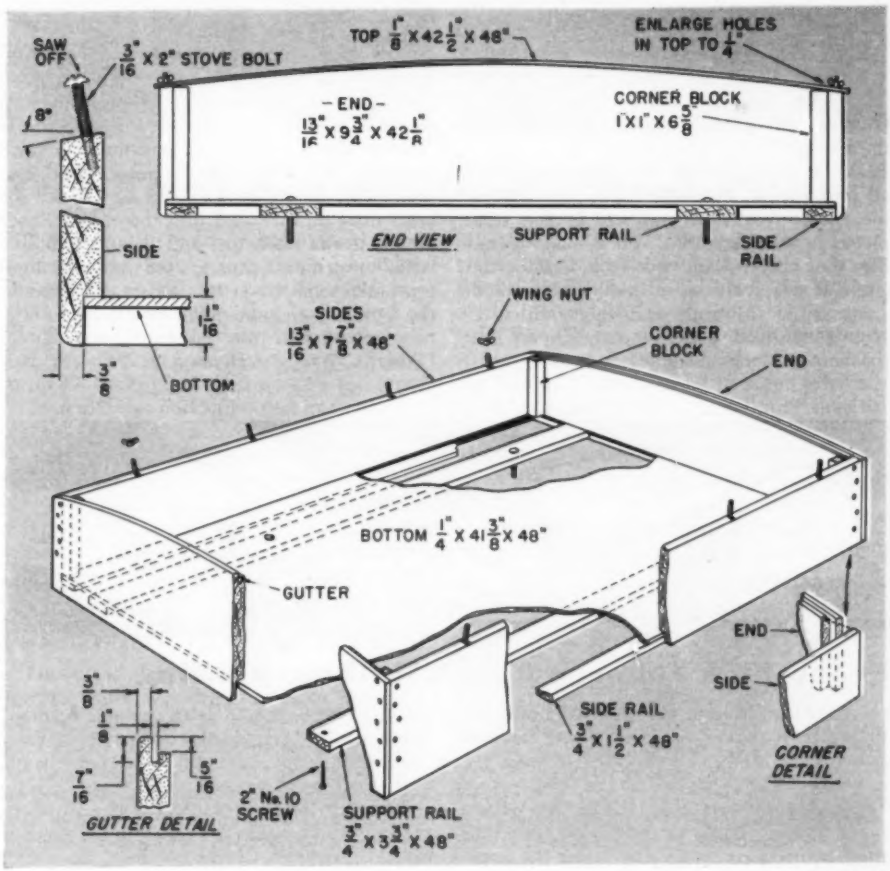


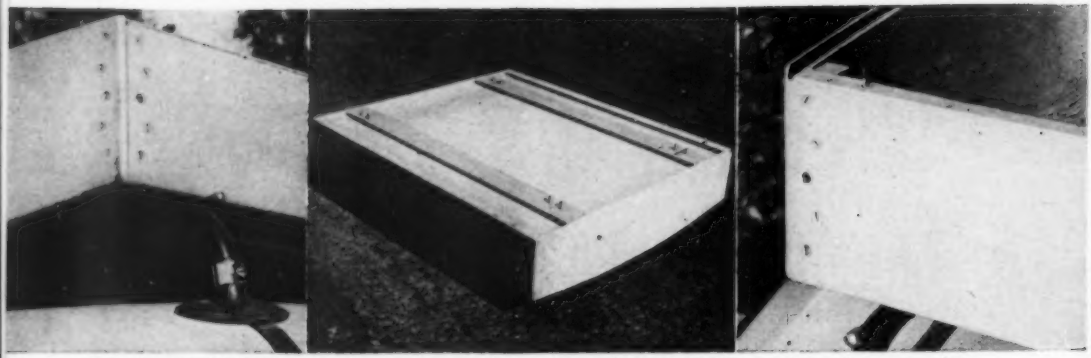
Car-Top Carrier Adds Outside Luggage Space

THERE'S little chance that rain will damage luggage in this carrier. Wind can't drive rain in, for the curved top panel rests below the ends. Drainage gutters in the ends carry off any seepage.

Make the ends and sides first, using white pine. Joint one edge of the stock and cut the pieces to finished length. Lay out the curve on each end and bandsaw to outline. Then clamp the pieces together and sand or plane smooth any irregularities.

Forming the gutters is easy on a shaper,





A rack to hold the box on the car top may be purchased. Attach the box with carriage bolts and pipe straps. A drainage gutter in each of the endpieces (right) carries off any surplus water. Note that a small notch should be cut in the sides in line with the gutters.

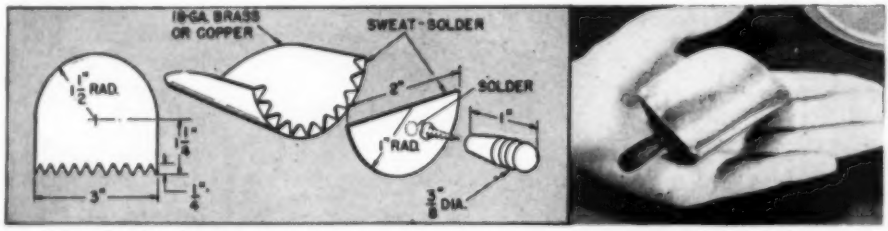
or with molding cutters on a drill press. Lacking that, use a dado head on the circular saw. Hold the stock vertically against the rip fence and rock it as you work. Make the shoulder for the top panel by holding the work flat on the saw table. Take several cuts at a tangent first. For the finish cut, rock the work against a guide line marked on the fence at the center of the blade.

Cut a rabbet inside the bottom edge of all four pieces, using the same saw setting for each. Next, saw rabbets in the endpieces to take the sides. Then make a trial fitting of one end and side to determine the angle at which the sides should be beveled.

Assemble the ends and sides with 1½" No. 10 flathead wood screws, driven into the corner blocks. Angle iron may be substituted for the blocks if desired. Cut the bottom plywood panel to fit the rabbets. Attach with ¾" No. 6 flathead screws.

Fasten the side and support rails to the ends with 2" No. 10 flathead screws. Attach the bottom panel to the rails with ¾" screws. Cut the top panel so that it just drops between the ends and extends beyond the sides about ¼".

With the top panel in position, lay out and drill four bolt holes. These should be small enough so that 3/16" by 2" stove bolts may be threaded into the sides. Saw off the heads afterward and equip the bolts with wing nuts. Enlarge the holes in the top panel to slip over the bolts easily. Sand the box smooth, and paint or lacquer it to harmonize with the finish of the car.—*Glenn A. Wagner, Delmar, N. Y.*

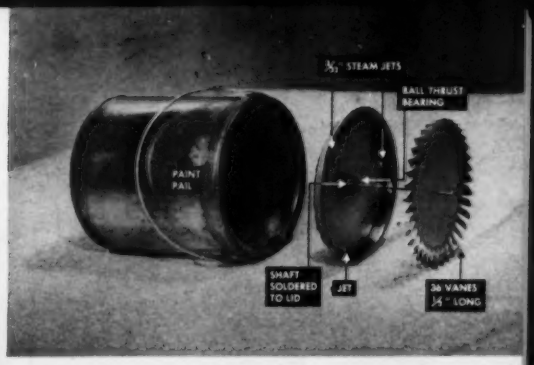


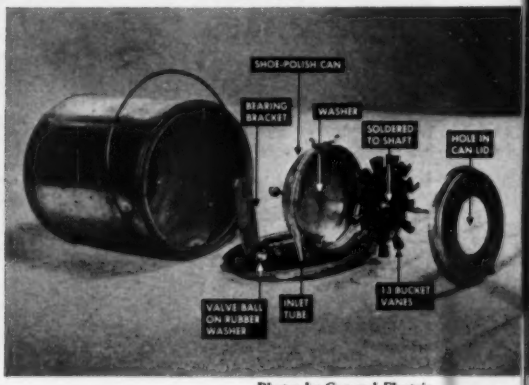
Scoop Fills Tobacco Pouch Without Spilling

This little scoop finally ended a long family feud. With it, I can now fill my tobacco pouch from a humidor or 1-lb. can—and get none on the floor.

Cut the body to shape with tin snips, notching one edge as indicated. Bend in these projections, and sweat-solder the semicircular end to them. Turn or carve a small ornamental wood handle, drill it for a flathead wood screw, and solder the screw head to the end of the scoop.

I tried to buy a suitable scoop. All were too long to fit inside the humidor. This one isn't.—*A. Zanelli, Clifton, N. J.*





Photos by General Electric

Toy Turbines Made of Paint Pails

THESE two tin-can working models afford a simple introduction to turbine principles. One, shown at left above and top right, has a horizontal rotor; the other has a vertical one in a shoe-polish can. Use paint pails with pry-off lids, and press them on lightly so they'll dislodge if pressure gets too high.

To make the horizontal turbine, solder a wire through the center of the lid. Punch three holes near the edge for jets, and give them a twist with a nail so they'll face the vanes. Cut a tin-plate rotor, punch a center hole, and bend the vanes. Use a glass bead or model-plane thrust bearing on the shaft.

For the other, cut a bucket rotor to run in a shoe-polish tin. Through its exact center solder a knitting-needle shaft. A U-shaped bracket on the lid holds the bottom of the polish can; steam enters it tangentially through some 3/32" tubing that's also soldered through the pail lid. The polish-can lid has a large central hole for exhaust. As an extra safety valve, punch a ¼" hole in the lid, cement a rubber washer around it, and put a ¾" steel ball or marble on it. Partly fill the pail with water and put on the stove.

The models were designed and built by Larry Buckland (above), both of whose parents are engineers for General Electric.

Powder-Puff Cases Hold Parts

THOSE clear plastic containers in which powder puffs and other cosmetic supplies are sold will come in handy around your workbench. Used as containers for small screws, nuts, rivets, brads, and tacks, they are convenient because you can identify contents at a quick glance. They won't break if dropped.—*Benjamin Nielsen, Aurora, Neb.*

Power Tools Lighten Edges Uniformly

How to use your home-workshop machines to touch up and ornament work with recesses, chamfers, and bevels.

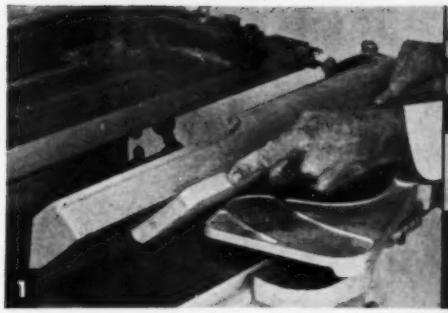
By Edwin M. Love

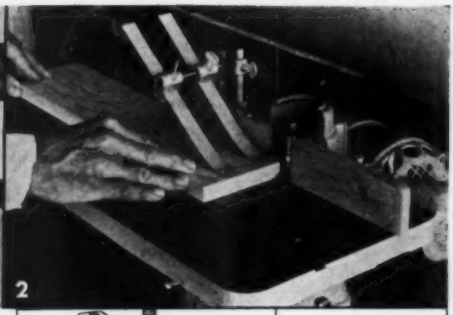
BEVELS and chamfers are meant to attract the eye—and they do. Look at any piece of furniture and note how your glance just naturally focuses on an edge that is out of square. But if the edges aren't uniform, the flatteringly light effect that chamfers can give will be more than offset. The first cut is a challenge; all others on the same piece must match it.

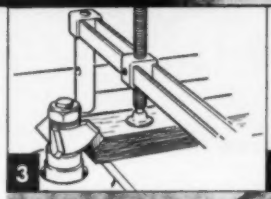
With power tools they do so almost automatically. Very often you don't even have to measure the angle of a cut so long as you keep the table setting the same for all steps. One pass over the cutter and the job is done exactly as you want it.

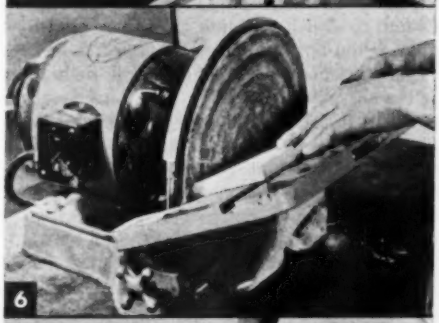
If you have a jointer, put it to work. Most chamfers and bevels are made with a 45-deg. setting, at which the depth of cut equals half its width. At times you may find it convenient to tilt the jointer fence to the left as shown in Fig. 1, since this may permit cutting with the grain where the other setting would compel a cut against it. For an accurate stopped chamfer, clamp a block to the fence at the proper point. A kickback block at the operator's end will provide for a stopped chamfer at both ends.

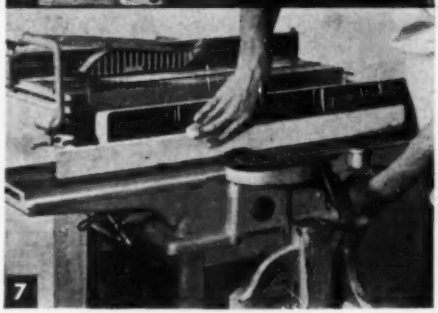
The shaper is an even more convenient tool for chamfering. Lying flat on the table, the board does not have to be supported against a slanting fence. Fig. 2 illustrates a setup for chamfering on the underside of a board. A V-cutter is used, but the blades are almost hidden by the work and the fingers are well guarded. Align the two faces of the fence and clamp them in such a position that the points of the cutter project a little more than the depth of the chamfer. Adjust the upper edges of the cutter to height, and make a test cut on scrap. Cut the chamfer by feeding the work against rotation and pressing the board into the fence. Kickback and stop blocks serve the same purpose here as on the jointer.









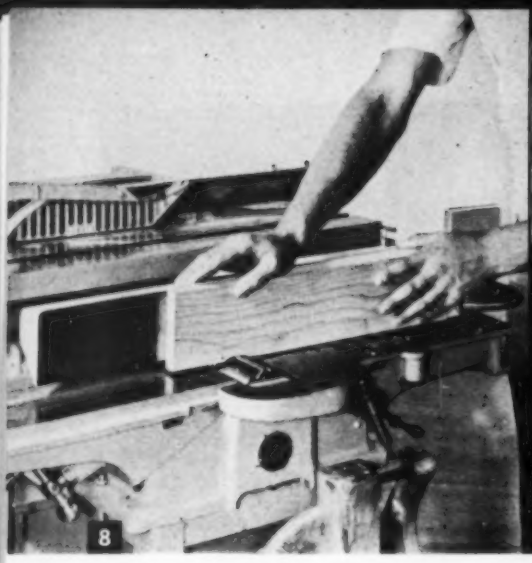


Occasionally it is necessary to chamfer the upper edge of a board with the lower half of the cutter in action (Fig. 3). Since the work passes between the table and the cutter, it follows that the chamfer will be even only if the board is of uniform thickness. The exposed cutter is also more dangerous, so use hold-downs and push sticks wherever possible.

Jointers, shapers, and other special-purpose tools are fine if you happen to have them, but even a modest circular saw can cut a chamfer with the best of them. Tilt the table as shown in Fig. 4, clamp a fence to the table, and slide the work between it and the blade. Whenever possible keep the work below the blade so that gravity helps hold it against the fence. The saw has a definite advantage when the edge is uneven to start with or there is a considerable amount of stock to be removed.

Other common tools that will do a good chamfering job are the drill press—in which the setup is essentially the same as that for a shaper—and the disk sander. The latter, used as in Fig. 6, is the slowest and is not recommended for deep cuts. It is fine, however, for touching up bevels or chamfers made with other tools. Slide the work lengthwise across the table and keep it in constant motion.

Beveling, as pointed out last month, removes an entire edge while chamfering takes away only part of it. However much they differ in function and appearance, the techniques employed to produce them are much the same. With slight resetting, most of the chamfering operations described above will also produce a bevel. The jointer fence is usually set to the right (Fig. 5). On a shaper a V-cutter can bevel only relatively thin stock. For thicker boards replace the V-cutter with a straight-blade unit, clamp a strip of wood on the table parallel



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with the fence, prop the work on this strip, and feed it into the cutters. The angle of the bevel is controlled by the thickness of the strip and its distance from the fence.

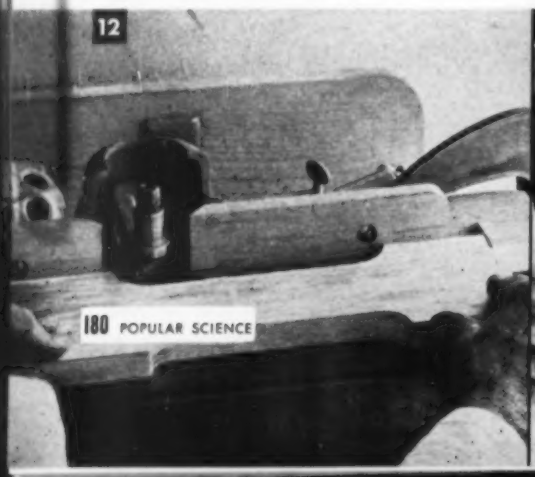
A circular saw is probably the best tool to use when a wide board is to be ripped into narrower beveled strips, since one cut yields two bevels. If you have a jointer to smooth the cuts with, the usual combination blade will suffice. Alternatively a hollow-ground miter saw will cut a bevel so smooth that only a touch of sandpaper will be needed to finish the job. Use the miter gauge when cutting an end bevel on a saw.

Like the marines, a jigsaw will rush to the rescue when you have no other beveling tool. In fact, it's pretty good for inside cuts. A bandsaw is still better. While still not the perfect choice, if used with a wide blade it will make a comparatively straight cut. If the table is grooved for a miter gauge and equipped with a ripping fence, use these accessories.

For recessing, the order of usefulness of these tools is somewhat different. A jointer will do very nicely, but only if the indentation to be made is less than ½" or so. The tables must first be brought to equal height, since only the center portion is to be cut away. Set the infeed table by the scale and level the outfeed table by bridging the cutter head with a notched straightedge as shown in Fig. 7.

The deep cut of the knives gives the work a sharp thrust, so clamp a kickback block to the near edge of the fence as an aid in starting the work into the cutters (Fig. 8). Once started, you will find it easy to push the work along.

After recessing, return the infeed table to its normal level. Next, joint a board far enough to project over the outfeed table, and then raise the latter to touch the board. For a further check, rest a board flat on the outfeed table so that the end projects over the cutter head as in Fig. 9. Turn the head



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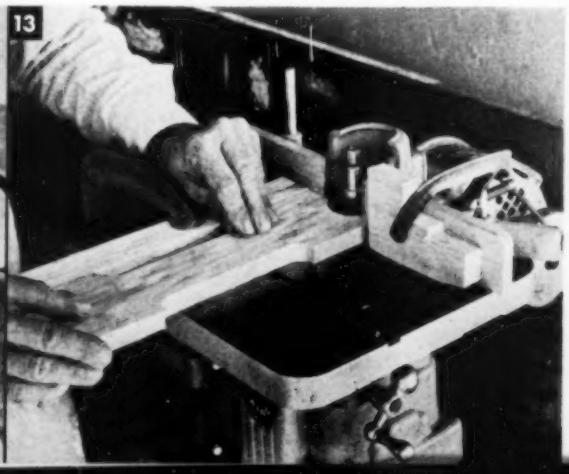

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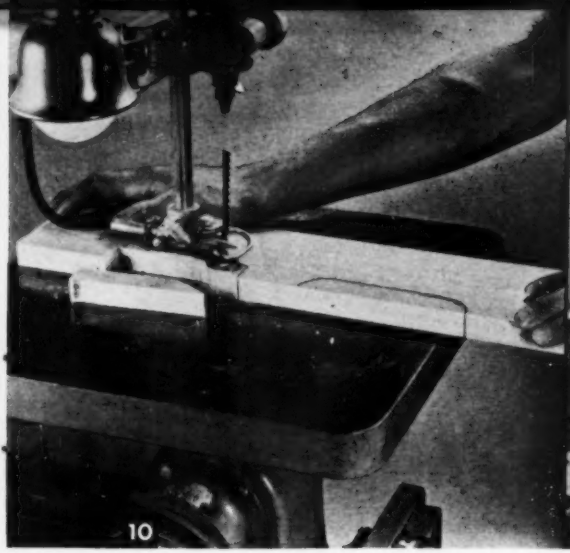

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by hand; if the table is at the proper level you will hear a faint scraping sound but there will be no lift on the board.

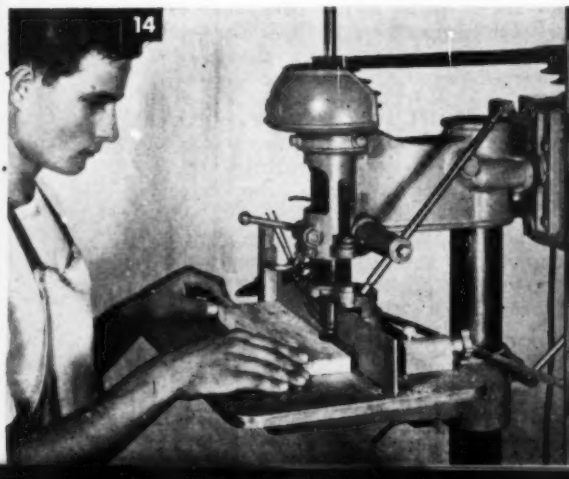
When the ends of a jointed recess are to be squared, trim them with a bandsaw, jigsaw, or handsaw. A touch of sandpaper completes the job.

Short and deep recesses are readily cut on a jigsaw. If the ends are coves, you can either follow the line in at one end and out the other or cut in from both ends toward the center. For square ends, cut straight in; then swing the saw in from one end and rip to the other. Finish by ripping from the other end as shown in Fig. 10. Follow the same procedure for recessing with a bandsaw.

A sawed recess usually requires smoothing. This job is quickly done with a 1″ abrasive belt used in place of the regular blade on a bandsaw or on a special sanding machine (Fig. 11). A flat backing guide used behind the belt prevents rounding of a sanded edge. If the cut has been made with reasonable care, hand sanding will also give a clean surface quickly.

A shaper can manage a deeper recess than a jointer. Mount a straight-edge cutter on the spindle. Set the fence sections in line and back far enough to give the necessary depth (Fig. 12). Deep cuts are better made with two or more passes. To recess the end of a medium width board, feed the work against the cutter, pushing the edge in along a wooden strip clamped to the table (Fig. 13). From this starting point push the piece across the table until the stop block is reached.

Fig. 14 illustrates the start of a recess on a drill press. Although the cutter is driven from above rather than from below, the operation is the same as on a shaper. Note the kickback block clamped to the far edge of the table. A stop block may be used at the forward end or the cut can be stopped at a pencil mark as in Fig. 15. END



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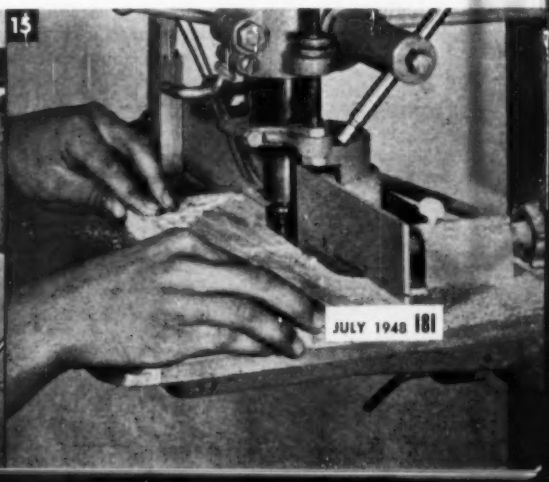

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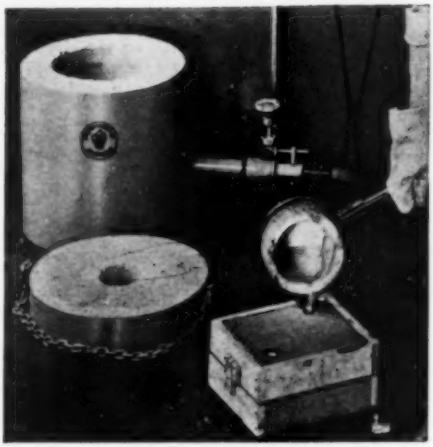
NEW TOOLS

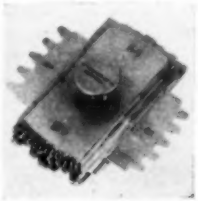
Foundry for Home Casting. An inexpensive furnace, complete with all equipment necessary for producing nonferrous castings, has been announced by the Sawyer Bailey Corp., of Buffalo, N. Y. Designed to burn cooking gas at the normal pressures supplied to the home, the furnace will withstand temperatures up to 2400 deg. F. Air may be supplied by a motor-driven blower or a household vacuum cleaner.

The furnace will take crucibles that have a working capacity of 10 lb. of aluminum or 34 lb. of brass or bronze. Sawyer Bailey supplies various casting alloys.



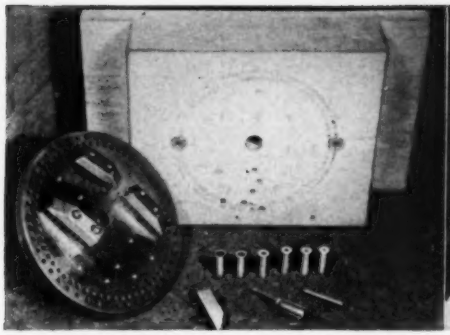
Push Drill Gets New Look. Made with a red plastic barrel, this new push drill is a product of the Miller Falls Co., of Greenfield, Mass. Molded in the handle are eight compartments to take drills from 1/16" to 11/64". These are supplied with the tool. An index ring at the top enables the user to choose the desired drill and remove it quickly from the container. Four steel jaws secure the fluted-shank drills.

Polish with Your Drill. An electric-drill attachment offered by the D. S. Bertram Engineering Co., Kansas City, Mo., may be used for polishing, buffing, and sanding. The bearings and gears operate in an oil bath in the aluminum housing. Selling for about $10, the set includes a 5" rubber disk, two sanding disks, and a polishing pad.

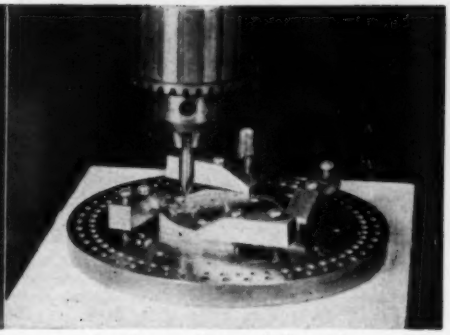


Gear Gauge. Here's a paper weight that also serves as a gear gauge. Made of stainless steel, the gauge set consists of 12 leaves. These include 24 different gear shapes of various pitch. A quick fitting of the gauge to a gear will quickly show the correct pitch—eliminating the necessity of counting the teeth and computing the pitch. Machined with the aid of special fixtures, the gauge teeth are of the correct involute shape. The George Scherr Co., of New York, developed it.

Level Built into Ruler. An inexpensive hardwood rule with horizontal and perpendicular levels is distributed by the Alexander-Wilson Co., of Los Angeles. Marked in 1/16" graduations, the rule is ⅜" thick, 1⅜" wide, and 18" long. Although designed for the handy man, the combination tool may prove useful to electricians and others as well. It sells for about $1.



Below the base, left to right, are the indexing plate, clamps, centering bushings, and index pin.



Spot holes for small-size drills with a center-drill first. Note index pin at back of plate.

Indexing Head for Your Drill Press

MOUNT this gadget on the drill press, and you can not only lay out holes or angles, but spot-drill right on the nose. Small spoked wheels, gears, locomotive boiler heads, and the like can be made with realistic precision.

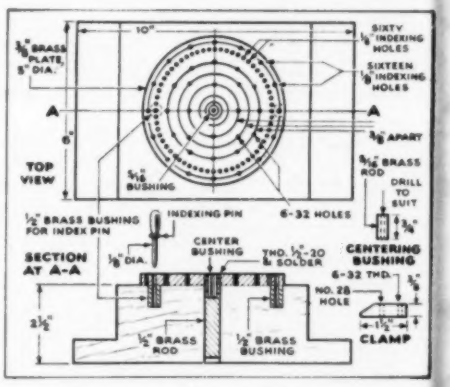
Cut a 5¼" circle of ⅜" brass or steel, tap ½"-20 at the center, and screw in a threaded stud. Run solder into the threads. In a lathe, turn to 5". Centerdrill 5/16" by ¾".

Scribe the five circles. Then, using the lathe index or a suitable gear mounted behind the plate, mark off the holes with a surface gauge set on the compound rest. (The number in the drawing should do, but more were drilled in the plate shown.)

Drill the wooden base a close fit for the ½" stud. Clamp the base on the drill press with an indexing circle aligned under a ⅛" drill. Rotate the plate to drill the holes. Tap clamping holes 6-32 and remove burrs.

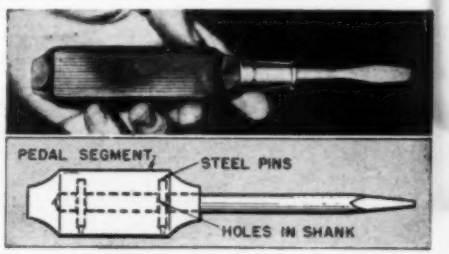
Press a bushing into the base under each indexing circle. Drill through one hole in each circle into the bushing. Make up the pin, 5/16" o.d. centering bushings drilled for various work sizes, and four clamp jaws.

Place the proper bushing on a pin or shaft that fits the center hole in the work, and clamp the latter on the plate. Turn the disk the required number of holes for each division (for example: 12 in the inner circle for five divisions; two in the outer circle for eight).—*Herbert R. Pfister, Bronx, N. Y.*



Part of Bike Pedal Forms Screwdriver Handle

INSTEAD of discarding screwdrivers with broken handles, you can give them a new grip with rubber from an old bike pedal. Force a pedal tread over the shank and drill two holes through both the rubber and shank. Fit steel pins into the holes to prevent the handle from turning. The pins should be short enough to permit the rubber to close over them, insuring a shockproof handle.—*D. G. Pittwood, Moscow, Idaho.*



This useful tool keeps fingers out of the way and will hold chisels in difficult-to-reach spots.

The holder solidly grips chisels and punches from ⅜" up to 1". It is all made of scrap steel.

Chisel Holder Spares Your Knuckles

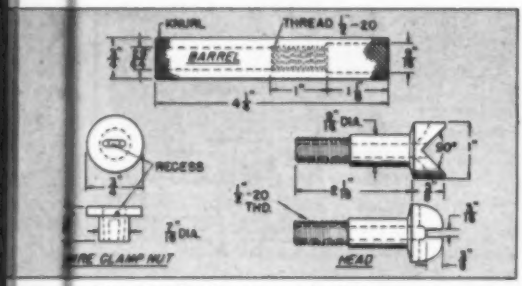
WITH this holder you can hit a chisel without worrying about your fingers. To make it, you need scrap steel and a foot of small wire rope such as ⅛" airplane cable.

Turn and knurl the barrel. Then drill and bore it and face both ends. Cut the thread with a hand tap. Turn the head to size, drill through, and make the V-cut in the milling attachment, if you have one. Use a keyway cutter for the slots. Both the V-notch and the slots may be filed.

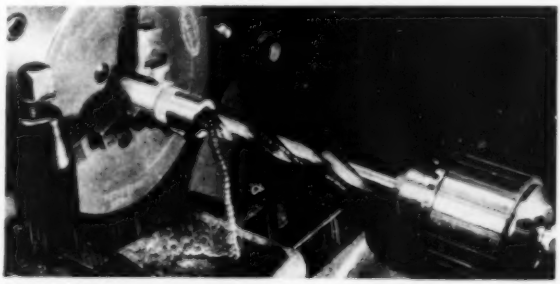
Turn the wire-clamp nut to shape, cut it off, and face it. Drill two holes, just large enough to take the wire, through the clamp at a slight angle. Chisel or rout a ¼" deep recess between the holes as indicated in the drawing.

The wire is held in the clamp by driving a wedge of soft metal into the slot between the holes. When you want to replace the wire, drill it and the wedge out of the slot.

Before anchoring the wire, assemble the tool. Make sure all parts work freely. Then screw the barrel and head tightly together. Place the wire around the largest chisel to be used and mark the wire. Disassemble the tool and anchor the wire as marked in the clamp nut. Reassemble it and your cold-chisel holder is ready for use.—*Will Thomas, Kenmore, N. Y.*

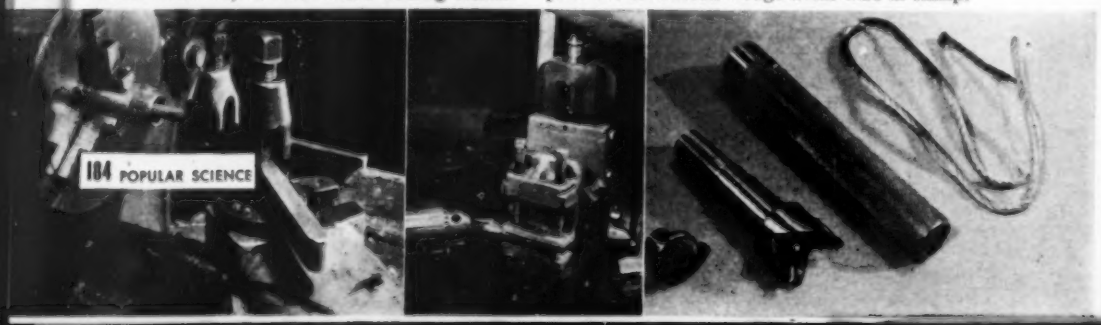


Slots in the head must be big enough to carry the wire around chisel shanks without binding.

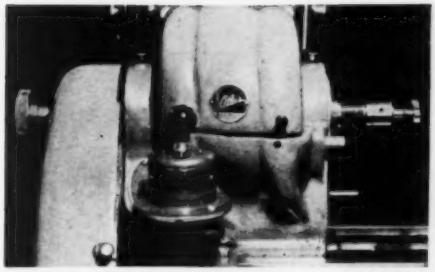


While drilling through barrel in the three-jaw chuck, protect the knurl with soft sheet metal.

Bore the head end of the barrel (left below) to the depth shown in the diagram. The notch in the head may be cut with a milling attachment or even a file. A piece of small wire rope and three machined parts (at right below) comprise the tool. Metal wedge holds wire in clamp.



Collet Holds Lathe Milling Cutters



Small cutters are chucked true in this holding collet, and there is little chance of slippage.

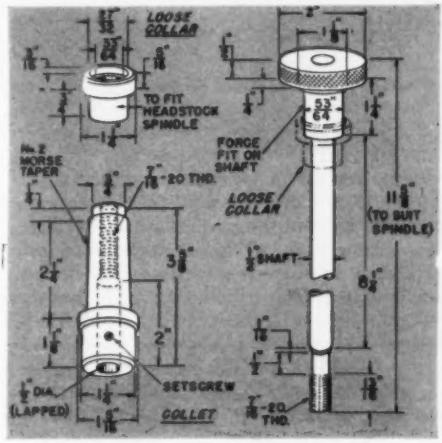
A MILLING attachment on your lathe opens up a whole new field for this versatile machine. Jobs that previously had to be done by hand can be turned out far more accurately and in less time.

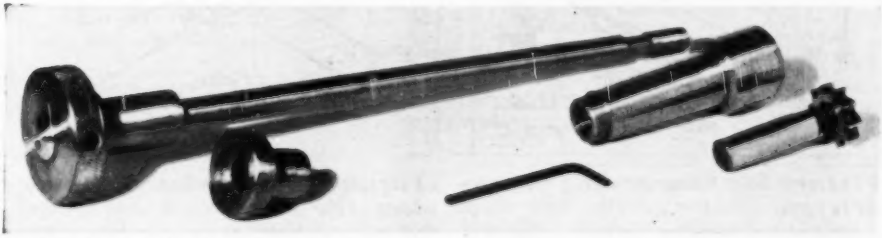
Accurate milling, however, calls for precision mounting of the cutters. Large cutters with a Morse taper shank fit into the spindle bore. Smaller ones with a ½" shank can be held in the universal chuck, but accuracy is sacrificed. The only way to hold such cutters precisely true is in a collet.

The one illustrated here requires a minimum of material. It was dimensioned for a 10" lathe, but a few changes will adapt the design to any lathe.

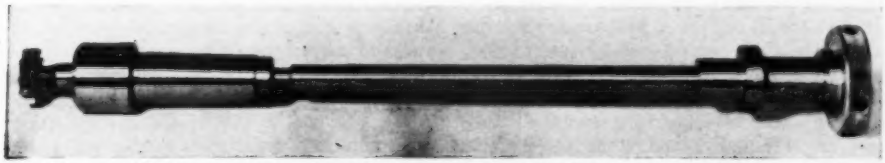
The Morse taper on the collet proper was cut by setting the compound rest to the correct angle. After the taper was cut, the collet was slipped into the spindle and a mark made on it to coincide with a spindle mark. Then the hole for the thread was drilled through and enlarged to the required depth for the cutter shanks. This hole should be drilled undersize and lapped to a perfect sliding fit. No looseness can be tolerated, as tightening up the setscrew would throw the cutter off center.

With extra arbors bored to hold cutters from small rotary tools, or dentists' burrs, even fine model and instrument parts can be shaped. Drive such small cutters at higher speeds.—*W. T. Warde, San Francisco.*

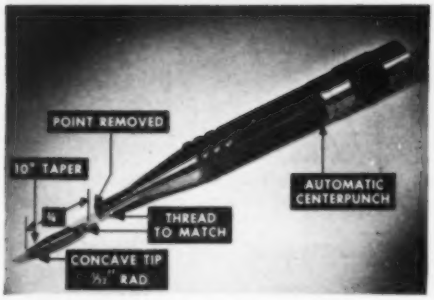


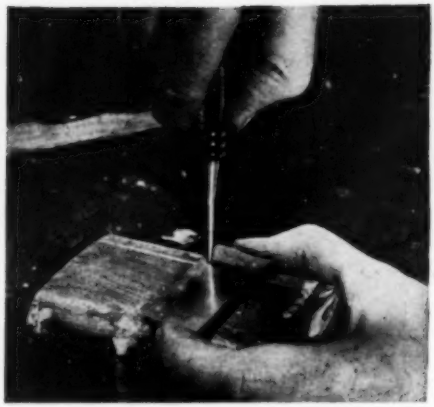


Shaft, collar, and collet proper are spread out here. A wrench locks the collet setscrew.



A trial assembly shows relationship of the parts. Lap the hole in the collet to a good fit.

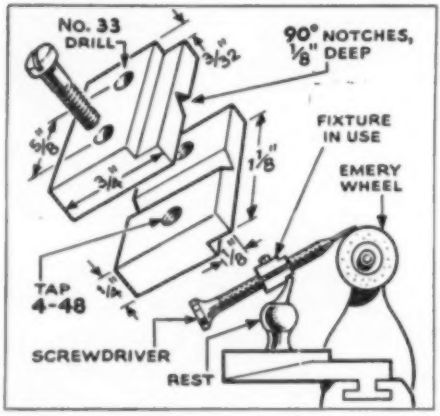




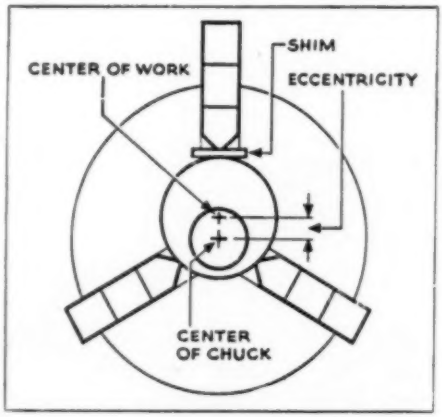
Punch Becomes Riveter. An ordinary automatic centerpunch—the kind that delivers a spring-actuated blow when the handle is depressed—makes a good riveter for use on models, instruments, and other fine work. Several strokes of the handle will mushroom an excellent head, for example, on a No. 18 escutcheon pin.

Turn a replacement point from 3/16″ drill rod, making it about ¾″ long. Form a little concave depression at the end of the tip, 1/16″ or less in diameter, using a round-nose bit. Thread the other end to fit your centerpunch (3-48 for the one shown).

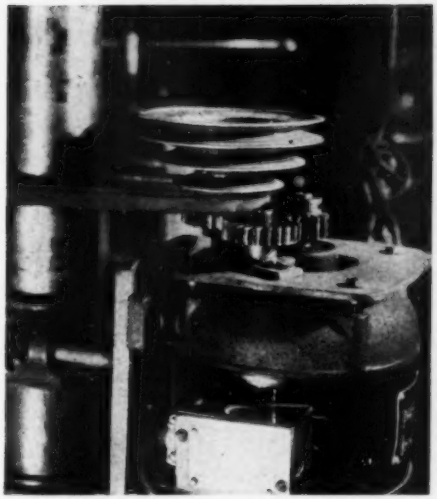
Harden the tip by heating it cherry red and quenching it in salt water, polish it bright, and temper by holding it cautiously in a flame until it begins to turn a light brown. Then requench it instantly in motor oil.—*Herbert R. Pfister, Bronx, N. Y.*

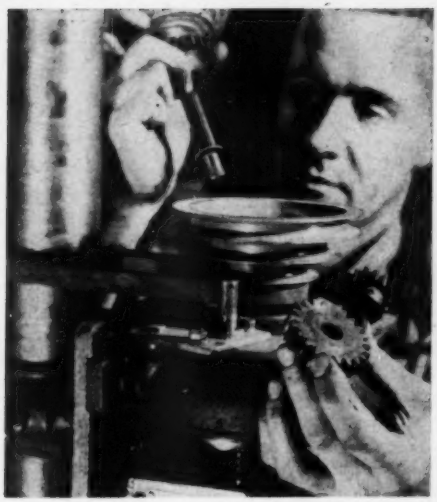


Fixture for Sharpening Screwdrivers. Grinding just the right shape on jeweler's screwdrivers is hard to do freehand, but it's a cinch with this little fixture. Make it of brass or dural. I use mine against the T-rest of a watchmaker's lathe in which a 1¼″ emery wheel is mounted, but it can be adapted to any grinder. Set the fixture and rest so that you grind a trifle back from the bit edge, turn over the fixture and grind equally, and stone the end to thickness.—*C. M. Chambers, Hampton, Va.*



Turning Eccentrics in Three-Jaw. One of the quickest ways of chucking work off center in the lathe for eccentric turning is to remove the No. 3 jaw of the chuck. Then turn the jaw-actuating scroll thread in the chuck the proper number of turns to secure the offset you wish, and replace the jaw. Since this will rarely ever give the exact amount of eccentricity desired, engage the jaw at the nearest oversize point and use a shim for the exact setting.—*Federico Strasser, Santiago, Chile.*

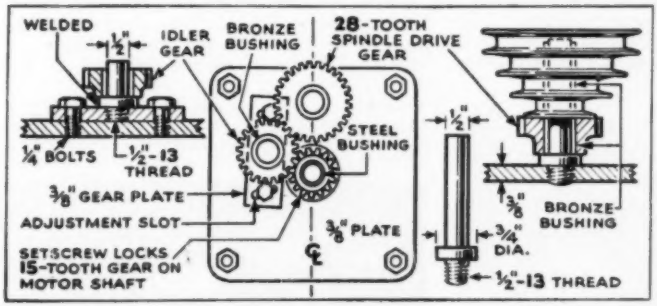




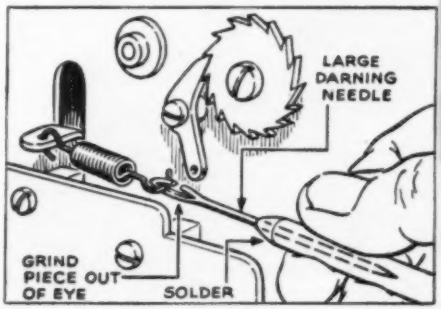
Drill Press Is Geared. Since I sometimes need a drill press that will produce holes up to 1″ in diameter, I made this speed-reducing gear train for my ½″ press. The rig in no way interferes with its regular use. With the gears shown (from a midget-car transmission) I get a spindle speed of about 215 r.p.m., fine for milling as well as heavy drilling.

The gears are mounted on a ⅜″ steel plate, held by extra long motor bolts and spacers. A central hole clears the motor shaft, on which is mounted a gear bushed down to ½″. Meshed with this is an idler running in a bronze bushing on a short steel stud that's threaded and welded to a small plate. Hold-down bolts running through slots secure this plate to the main one and permit adjustment to suit different gears.

The final gear runs on a steel stud directly in line with the motor shaft and drill spindle. A four-step pulley was bored out to a press fit on a long bronze bushing that is likewise press-fitted to the gear. Some 3/16″ steel pins are also driven diagonally from pulley flange into gear.—*Carl K. Jean, Parker, Ind.*



Needle Unhooks Springs. This little gadget is very useful when you're working on typewriters and other crowded mechanisms. Trying to unhook (or worse, to hook) small tension springs by hand or with long-nose pliers is often exasperating. The tool at right, which makes the job easy, is merely a darning needle soldered in a tubing handle. One side of the eye is nicked open on a grinder. If you prefer, the needle can also be held by a setscrew meeting a hole in a rod.—*Andrew Vena, Philadelphia.*



Shoot Late for Striking Photos

Moonlight shots are one effect you can create in late afternoon. This photo of a Cape Cod fisherman returning to port at 6:30 p.m. was made on Super Panchro Press Ⓣ Type B film with a Wratten G (orange) filter, 1/200 sec. at f/8. Haze prevented flare in the lens.

Outdoor portraits in the late afternoon gain brilliance and depth. These Japanese children were photographed at 5:30 p.m. in October on Super XX Ⓣ film pack, 1/200 at f/6:3.

Lighthouses come to life only at night. It is therefore appropriate to give them a nocturnal setting. This one was shot at 4 p.m. with a Wratten G. The print was slightly diffused.

Shadows add texture and crispness to this view of a Japanese spreading rice on straw mats to dry. If you want texture, always shoot in the late afternoon. Each object, however small, will stand out against the sharp shadow that it casts. In this case the time was 4 p.m.

Don't fold up your camera when the sun dips toward the horizon. Late afternoon gives many good photos.

By Robert F. Smith

AS LONG as any daylight remains, it's never too late for successful outdoor photos. All too often shutters stop clicking when the sun reaches an angle of about 30 deg. Actually, that's a good time to be starting.

In the late afternoon the sun gives more warmth and texture to a photo than at any other time of the day. It also offers latitude in the treatment of a subject. A scene may be recorded realistically or not—depending on your whim of the moment. Proper choice of filter, for instance, produces a moonlight scene.

The adjoining photograph of the lighthouse is an example of the latter. Like zombies, lighthouses don't come to life until after dark. They are the glowing sentinels of the mariner at night—and should be portrayed as such. Late afternoon light, combined with a Wratten G filter, gave the desired effect—a lonely light in the darkness.

Now let's consider a late shot handled straight—the photograph of the Japanese torii on the following page. Here all the texture and warm tones are faithfully recorded. This results from the oblique angle at which the light hit the subject. Every blade of grass casts a well-defined shadow, creating texture. To enhance the tonal quality, a K-2 (medium yellow) filter was used, allowing the warm tones to register and dropping out enough of the blue to intensify the shadows.

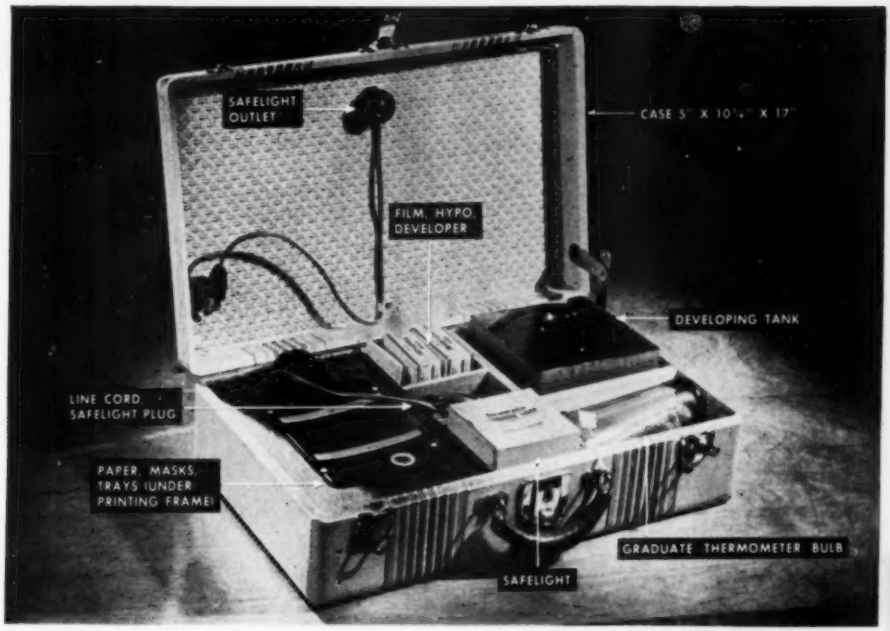
Outdoor portraits taken as the sun nears the horizon have a sparkle, brilliance, and depth that is next to impossible to duplicate

Long shadows at 4 p.m. bring out the detail in this typical Japanese scene. Good modeling and long scale are always advantages of shooting in the final hours of the day. The exposure here was 1/200 at f/11 on Super XX with a K-2 filter. Notice the texture in the stone.

with any other light source—certainly with any equipment available to the ordinary amateur. In recent years the technique of synchro-sunlight—supplementing natural light with flash—has become very popular. At its very best, however, this does not compare with good late sunlight results.

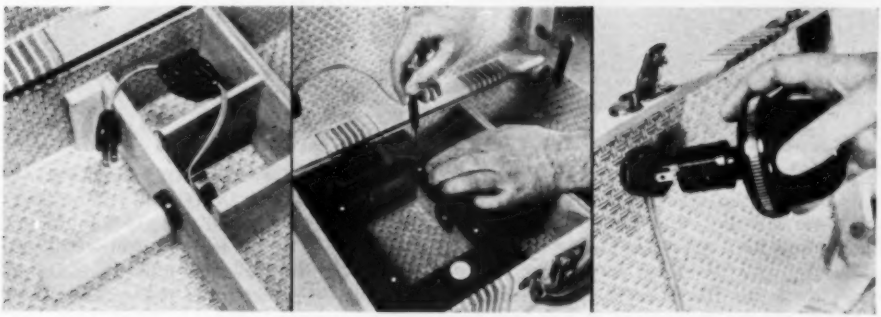
Made at 5:30 of a clear October afternoon, the accompanying photo of the two Japanese children illustrates the roundness, modeling, and long scale achieved by this means. A late afternoon sun is rich in red and yellow light. A K-2 filter allows this light to register and cuts out sufficient blue to darken the sky slightly.

Choice of film and developer is important for late-light photography. An emulsion with fine grain, long scale, and moderate contrast is usually best. Typical good film and developer combinations are as follows: 35-mm. Panatomic X Ⓣ and Edwal Super 20 Ⓣ; 120 and 620 Plus X Ⓣ and Microdol Ⓣ or Edwal Super 20; and Super XX sheet and Microdol or D-76 developer. END



Darkroom Fits the Case

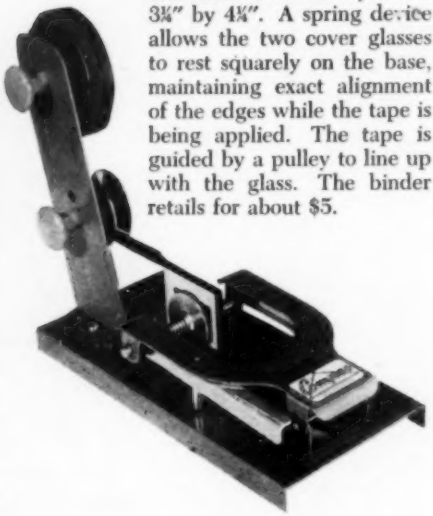
WOULD you like to see your vacation photos before returning home? This suitcase holds everything needed to develop roll film and make contact prints. Adjust the size of the compartments to suit your equipment. The partitions are ¼" plywood. A 115-volt line leads to an outlet receptacle on the printer. Safelight and printing light are plugged into this. A feed-through switch turns the printing light on and off.—*Arthur C. Miller, Manhattan, N. Y.*



A contact printer was built in. It consists of a 3¼" by 5½" metal printing frame set in a sheet of plywood, with a 25-watt frosted bulb centered underneath. Drill the frame edges for screws. For traveling, both the printing and safelight bulbs are taken from their sockets. Trays, paper, masks, stirring rod, film clips, and sponge fit into the printer compartment.

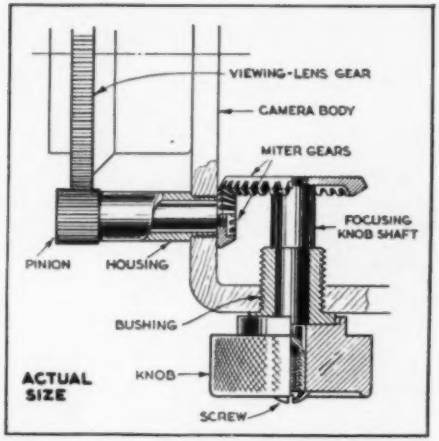
Arrow Overcomes Parallax. For twin-lens close-ups, center the subject in the finder, rest the square end of a cardboard arrow against the taking lens, and readjust the camera so the arrow points to the center of the subject.—*Ken Murray, Colon, Mich.*

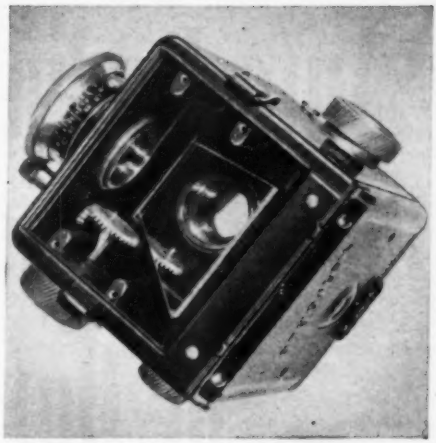
Binder Guards Transparencies. A new binder offered by the Comco Corporation, of Chicago, accommodates all standard slides from 2″ by 2″ to 3¼″ by 4¼″. A spring device allows the two cover glasses to rest squarely on the base, maintaining exact alignment of the edges while the tape is being applied. The tape is guided by a pulley to line up with the glass. The binder retails for about $5.



Film Washed in Can. An ordinary tin can with holes punched or drilled around the lower rim offers a means of washing roll film thoroughly. After the loaded reel is in the can, place it under the faucet. The water then can flow out through the holes, carrying all the hypo with it. A fruit or vegetable can fits this particular tank reel. A coffee can could be used for the larger type.—*R. P. Stevenson, Manhattan, N. Y.*

Telephoto Lens for Reflex. A supplementary lens introduced by the Morton Company, of Minneapolis, Minn., makes it possible to take telephoto shots with any camera. In the case of a reflex, the second lens can be placed over the focusing lens while framing the shot. Then it can be slipped over the taking lens. The lens is coated and has a built-in adapter ring for filters. Finders may be masked to suit.





Side Focusing Added to Reflex. A side focusing knob that I have installed on my reflex camera increases both its usefulness and convenience. For instance, focusing while using a flash attachment was an awkward procedure without the knob. The knob overcomes this. About one turn covers the entire focusing range.

All parts were made of aluminum alloy. They are shown above actual size. The job may be done entirely on a lathe, except for the pinion gear that meshes with the viewing lens. This was cut on a milling machine after a fly cutter had been ground to shape with a lens-gear tooth as a template. The miter gears were purchased, and the hub projections faced off. The pinion that meshes with the viewing-lens gear was mounted about 3/16″ below the horizontal center line of the lens.—*John J. Harper, Atlanta, Ga.*

Water Controls Temperature. Water flowing through a molded rubber device introduced by the Morse Instrument Co., of Hudson, Ohio, keeps solution temperature even. A hose is connected to a mixer faucet and the water adjusted to the desired temperature. The tray of solution is then rested on the device in a sink or other spot where the water can overflow. It's now made only for 11″ by 14″ trays.

Pencil Lines Aid Cropping. When the image fills certain negatives to all edges, you often can't make a print to fill projection paper of normal proportions. For instance, an image that fills a 2¼″ by 3¼″ negative can't be printed to fill 8″ by 10″ paper except by lopping off one end of the image. To avoid this, make pencil lines on the ground glass, as above, or mask the finder to keep the image within a 2¼″ by 2¾″ area.

Auto Radio Plays In Car or Out

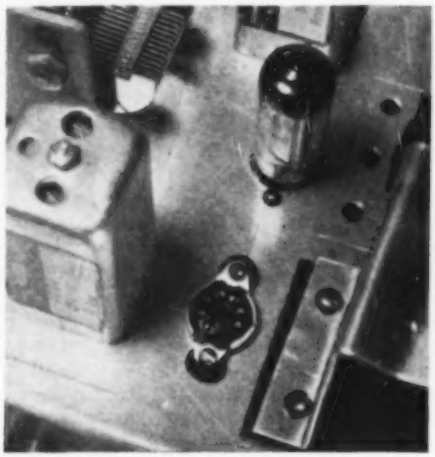
Powered either by the car battery or its own rechargeable storage cells, this set offers real versatility.

By Edward Blanton

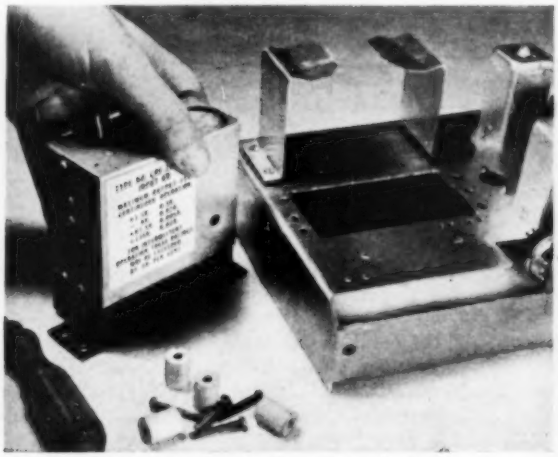
A RADIO can be as important a part of a day in the country as hot dogs and soda pop. It fills in that tired hour of the drive home, keeps you posted on news or ball scores, or brings your favorite music and comedy right out to the picnic grounds.

For all this you'd ordinarily need two sets —a portable plus one in the car. But not with the one double-purpose receiver pictured here. It's a self-contained portable that operates on its own rechargeable battery. Plug in a lead from the car battery, and it turns into a full-fledged auto radio.

Not every portable is suitable for car use, as you may already have discovered. It needs better-than-average volume to com-



Detector-tube socket is on rubber grommets to damp out vibrations and reduce microphonics.



Cut an opening in the chassis so the vibrator can be mounted partly above and partly below.

pete with road noises, and good sensitivity to keep it from getting off the beam as you drive farther away from the transmitter. This set has both, yet it's compact enough to be carried about easily.

Miniature tubes, coils, and other components partly account for the small size of this powerful receiver, but a couple of war-surplus items contributed the most important share. Both the small 6-volt storage battery and the filtered vibrator were made originally for the Navy; they were readily available in surplus stores at the time this receiver was built. The two items were purchased for $5.50, of which $1.50 was for the battery. This price, of course, may vary. These items are not standard, so make sure you have them on hand before you invest in other components.

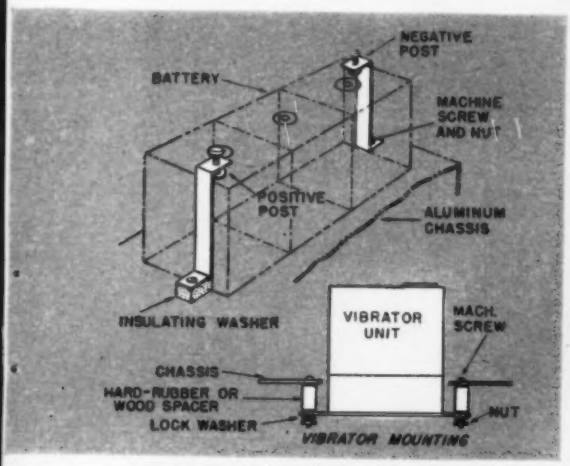
The battery is encased in transparent polystyrene and measures approximately 1⅞" by 2½" by 3¾". It will run the set for about five hours on a charge, and can be recharged about 30 times. The vibrator, unlike most standard units, delivers a bias potential of -6 volts as well as B voltages of 67½ and 135, and 1.5 volts for the filaments. Don't try to use this battery with an ordinary vibrator or you may run into trouble on several counts. For one thing the drain will probably be too high. Also you would have to make provision for filtering and providing C bias voltage.

To get the sensitivity required, a tuned radio-frequency stage is used ahead of the converter. The first 1T4 tube is the heart of this stage. An antenna coil, tuned by the first section of the three-gang variable condenser (C1A) is connected directly to the signal grid of this tube. As you can see in the diagram on page 196, a choice of two different antenna couplings is offered. Note that the telescopic antenna goes directly to the secondary winding of L1—that is, to the signal grid of the 1T4. This improves sensitivity, but somewhat reduces selectivity. The other connection reverses this situation. You will probably find that the external whip antenna (the one that you will install on the car) gives better results when connected to the small primary winding of L1, but you can juggle the inputs for best results.

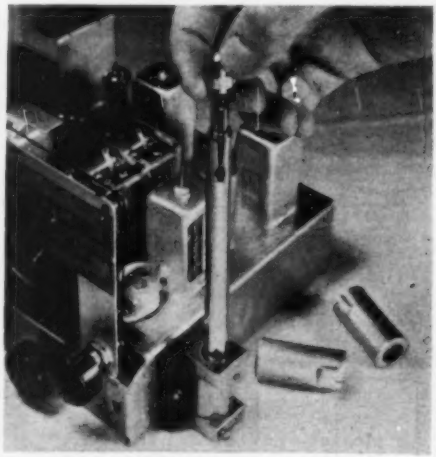
Both mixer and oscillator functions are performed by the 1R5 tube. An adjustable trimmer condenser (C4) with maximum capacity of 400-500 mmf. is wired in series with the third gang of the tuning capacitor (C1c) in order to reduce its capacity.

The output IF transformer is coupled to the diode detector portion of the dual-purpose 1S5. This tube is mounted on rubber grommets to cushion it against vibration. Movement, or even the backlash of sound waves from the speaker, might otherwise cause the tube to become microphonic.

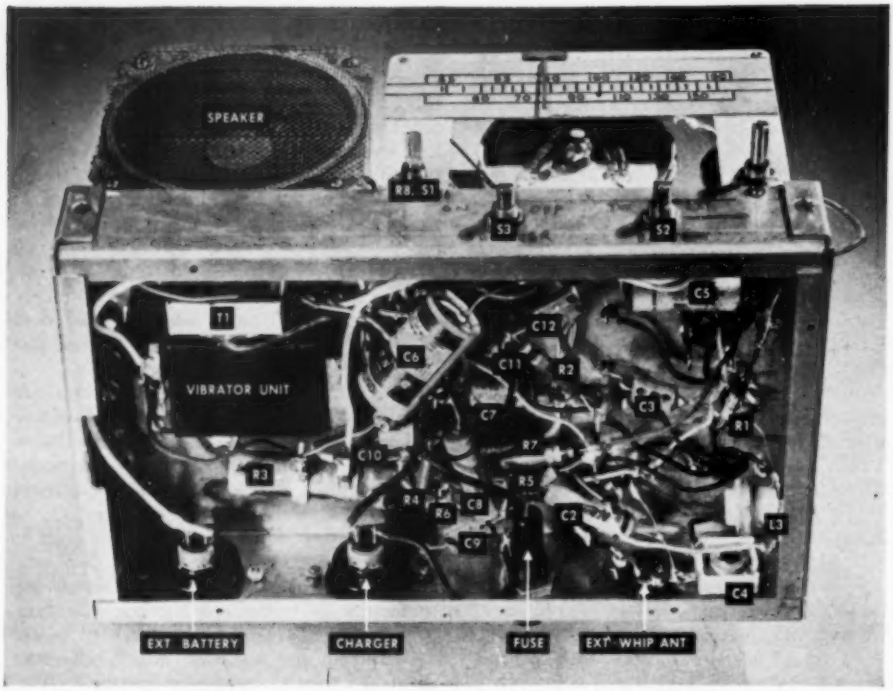
The new 3A4 miniature power tube used in the output circuit can handle cleanly almost 1 watt of power. This is nearly equal in volume to that obtained from an AC-DC receiver and is ample for most conditions in a car or out. The current drain of the 3A4 filaments would overload the 1.5-volt



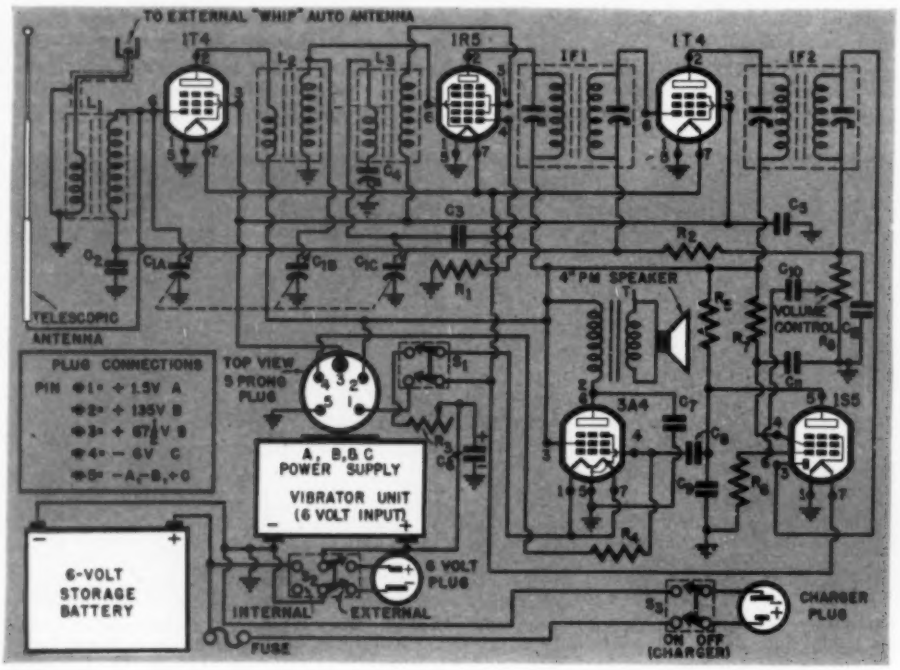
Recommended methods of installing the storage battery and vibrator are shown in this sketch.

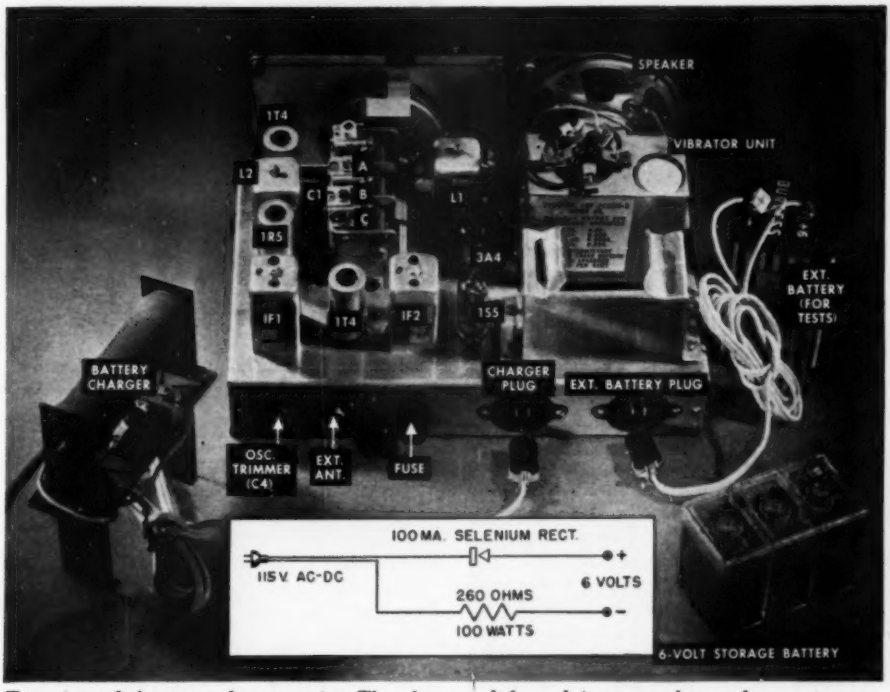


For preliminary aligning and checking, fasten the telescopic antenna directly to the chassis.



Depending on the cabinet you plan to use, you may have to rearrange the parts shown here.





Top view of the set and accessories. The charger, left and inset, works on house current.

tap of the vibrator, so the tube is fed directly from the 6-volt battery. In order to drop the 6 volts to 1.5, a 25-ohm, 10-watt wire-wound resistor (R3) is placed in series with the leads. This is an adjustable resistor. Set it at maximum and move the slide inward gradually until the voltage across pins 1 and 5 of the 3A4 reads 1.5. (If you don't have a low-range voltmeter, you had better get one since you'll need it later on to check the battery). In conjunction with C6, R3 forms part of the hash filter.

Hash is the noisy buzz created by the vibrator, and it may vary from set to set. In this case a dry electrolytic of 100-mfd. capacity was found to be adequate for C6. You may have to increase this to 500 mfd.

Laying out the parts for this set calls for some calculation in terms of your own specific needs. Remember that you not only want to get the whole works into a compact portable case, but that you must also proportion it for a convenient fit in the car.

In some autos there will be sufficient leg

LIST OF PARTS

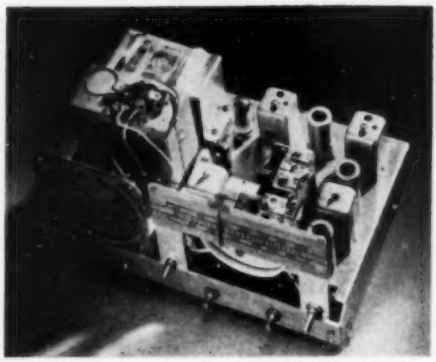
All carbon resistors 1 watt.
R1: 75,000-ohm carbon.
R2: 3-meg. carbon.
R3: 25-ohm, 10-watt adjustable wire-wound.
R4, R7: 1-meg. carbon.
R5: 250,000-ohm carbon.
R6: 5-meg. carbon.
R8: 1-meg. potentiometer with DPST switch (S1).
All paper condensers 400 volts.
C1 A, B, C: 3-gang tuning condenser, 365 mmf. each section.
C2, C8, C11: .05-mfd. paper.
C3: .0001-mfd. mica.
C4: .0004-mfd. adjustable trimmer.
C5: .1-mfd. paper.
C6: 100-mfd., 25-volt dry electrolytic (see text).
C7: .004-mfd. paper.
C9, C12: .0002-mfd. mica.
C10: .005-mfd. paper
L1: Adjustable iron-core antenna coil.
L2: Adjustable iron-core RF coil.
L3: Air or iron-core oscillator coil, 456 kc. (must be shielded if placed above chassis).
IF1, IF2: Iron-core IF transformers, 456 kc. input and output (output for single-diode detection).
S1, S3: DPST rotary (S1 on R8).
S2: DPDT rotary.
T1: Universal output transformer.
6-volt nonspillable storage battery (Willard NT-6, or Navy type CWB 19046).
Low-drain vibrator (Navy type CRF 20221-A). Input, 6-volts; output, 1.5, 67½, 135, and -6 volts.
4" P.M. speaker; tuning-dial assembly; telescopic antenna (approx. 28" extended); aluminum chassis, 2" by 7" by 11" or other; crackle-finish cabinet 6" by 7" by 12" or other; 5-prong plug for vibrator; miniature tubes and 7-pin sockets; miniature tube shields (three); connector for external antenna; polarized recessed plugs (two) for charger and external battery, with matching female connectors; fuse and holder for chassis mounting.

room to allow for mounting under the dash; in others this position will guarantee a scored shin every time you get in or out. Perhaps you will find it more convenient to bring battery and antenna leads up through the back of the seat and keep the set next to you. Or maybe you want to mount it on the rear-window deck.

Whichever way you decide to do it, figure out your maximum allowable dimensions before you start to lay out the chassis. To keep over-all height to a minimum, the chassis in this set was cut out so that the vibrator unit and the speaker could extend both above and below. The sketch at the bottom of page 195 gives a suggestion for mounting the vibrator. Note in the same sketch the recommended method of installing the storage-battery clips. The narrow posts shown in the drawing are probably better than the wide bands that can be seen in the photos, since they are less likely to cover the vent holes in the battery. Also the screws give positive electrical contact.

Ventilation of the battery cells is extremely important. Provide a removable back or several fair-sized holes in the cabinet if you plan to charge the battery in the set. Without ventilation the active gases created during charging will cause corrosion of the metal parts. A touch of petroleum jelly will help to protect the contacts.

There are two ways of charging the battery, and you will undoubtedly find it desirable to use both at different times. One is by means of a house-current charger shown on page 197 and diagrammed in the inset.



Complete except for the case, this combination radio is no larger than a good-sized portable.

The output of the charger may be connected directly to the battery terminals (observing polarity, of course) or the leads may be plugged into the appropriate contacts on the back of the chassis. You can leave this charger on for about 20 hours.

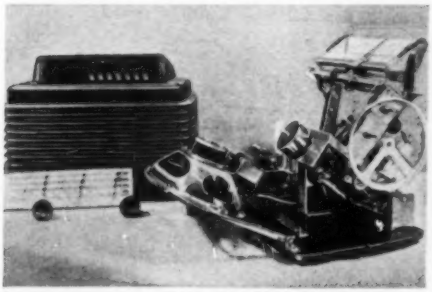
The other charging method consists of connecting the radio battery in parallel with the car battery.

Once you have the parts mounted and wired, the next step is to align the tuned circuits of the receiver. With luck this may be done by ear, but the most reliable method is to use a signal generator. If you don't have one you can undoubtedly get a local service man to peak the set for you. Make sure that you test both the internal and external battery circuits. For the latter you can use a 6-volt lantern battery. END

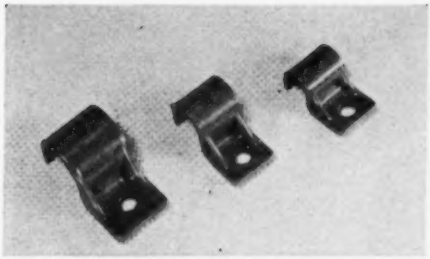
Working on its own battery, the set is ideal for picnics, boating trips, or beach parties.

Plug in the car battery and your whip antenna, flick the switch, and you have an auto radio.

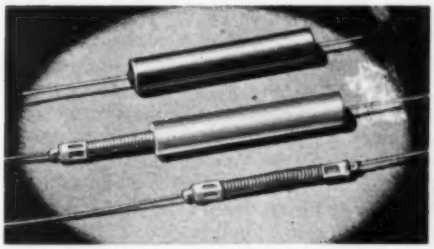
Battery Cells Interlock. A new type of dry-cell battery has been developed for portable radio and hearing-aid use by Olin Industries, Inc., New Haven, Conn. The electrolyte is packed into molded plastic cells which are shaped with interlocking flanges so that they can be assembled in stacks. This construction is used in what is said to be the smallest 67½-volt battery ever to be manufactured commercially. It's half the size of standard batteries.



Radio Opens for Servicing. Removing one bolt from this British-made radio allows the chassis to hinge open, making every part readily accessible for testing and servicing. Shown recently at the British Industries Fair in London and Birmingham, the new receiver, called the Ultra Radio Ⓣ, is pictured above together with its plastic cabinet.

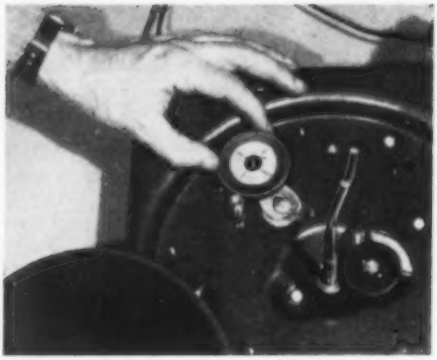


Clamps Molded in Plastic. Corrosion-resisting cable clamps of tough molded plastic lessen the possibility of short-circuiting worn wires and cables. American Molded Products Co., Chicago, makes the clamps in three sizes.



Resistors Cased in Ceramic. Midget wire-wound resistors, sealed in steatite tubes, can be used in place of bracket-mounted resistors where space is at a premium. Rated at 7 watts, these Greenohm Juniors Ⓣ, made by Clarostat, measure only 5/16″ dia. by 1¾″ and are made in values from nearly zero to 5,000 ohms. They come with 2″ bare pigtail leads.

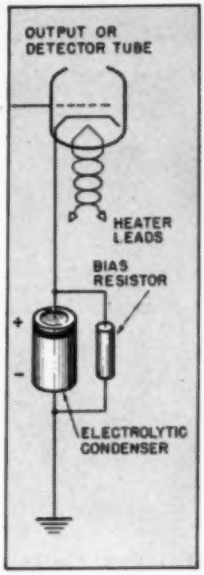
Antenna Mounts on Chimney. A mast holder that can be installed on any chimney in a few minutes will ease the problem of installing television and FM antennas. Two galvanized steel bands large enough to encompass any chimney are supplied with the mount. The unit can also be screwed to the side of a building or to a wooden post. South River Metal Products Company, South River, N. J., makes the mount to sell for $7.50.



Flat on Idler Bumps Turntable

RUBBER-COVERED idler wheels used between the driver and turntable rim on rim-driven phono motors may develop a flat if left standing in one position. Flats cause an audible bump at every revolution of the turntable; they are most likely to develop during the hot summer months. Before going away for the summer, unseat the turntable to relieve pressure on the idler. And if the trouble should develop, you can replace the idler or turn it down carefully on a lathe to restore perfect roundness.

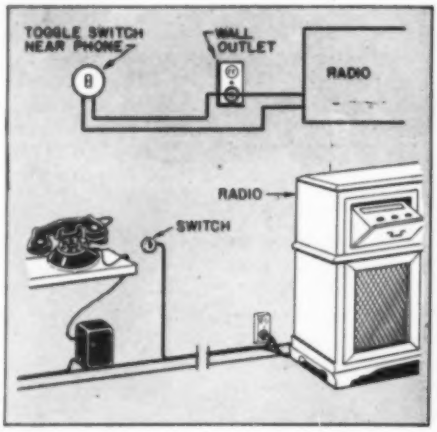
Troubles Traced to Condensers



DISTORTION, loss of volume, and squealing in a radio can often be traced to a faulty electrolytic condenser in the cathode of the power output tube. A typical value of this condenser is 25 mfd., 50 volts.

When a set suddenly loses volume but can be brought back by banging the cabinet or flicking a light switch in the room, the electrolytic in the cathode of the second detector (57, 6C6, 6J7, etc.) may be leaky. Its value is 5 mfd., 25 volts.

In replacing either of these bias condensers, connect the positive terminal to the cathode and the negative lead to the chassis or other ground.—*Frank Tobin, Manhattan, N. Y.*

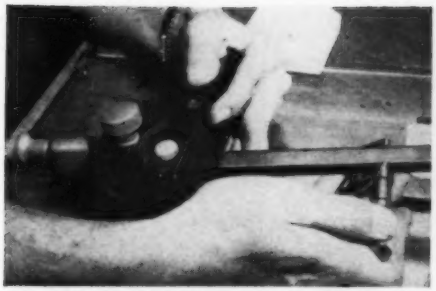


Switch Near Phone Cuts Radio

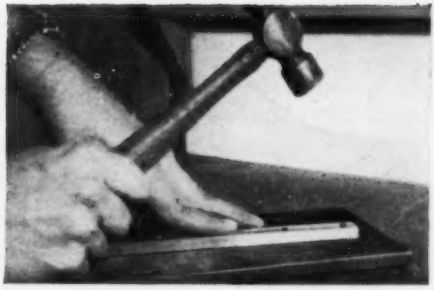
TIRED of running to reduce radio volume every time the phone rang, we mounted a toggle switch near the telephone. By connecting it in series with the radio line cord, we can now turn the set off right at the phone. The wire leading from switch to radio is stapled to the baseboard.—*Arthur Trauffer, Council Bluffs, Iowa.*

Tape Reduces Shock Hazard

THE tiny zeroing screw on the face of a 0-300-ma. plate meter on a transmitter proved to be loaded with high voltage. An accidental touch produced a painful and unexpected shock. To prevent recurrence, I covered the head with adhesive tape. It is easily removed when adjustment is necessary.—*D. J. Bachner, Queens, N. Y.*



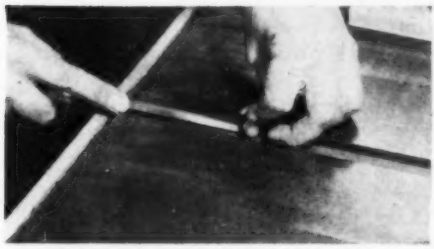
Check the wear on the miter-gauge bar with a micrometer. Heaviest wear occurs at the ends.



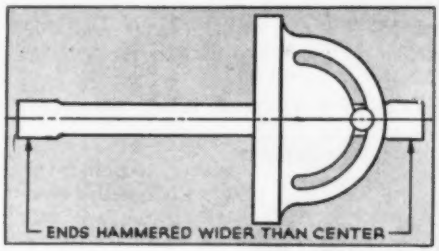
Hammer out extra width on the ends of the bar to compensate for the amount that's worn away.

File the edges of the widened area until the bar just fits snugly. Keep the edges square.

The table groove also may wear. If the bar binds at certain points, file the groove there.



Use a triangular file to clean out the groove corners. Check the fit of the bar frequently.



Flatten the bar once more and file the edges again if dressing the groove leaves it slack.

Restoring the Accuracy of a Miter Gauge

HERE's a method of reconditioning the miter-gauge bar of an old circular saw. If the bar is worn to a slack fit in the table groove, it's hard to cut accurate angles.

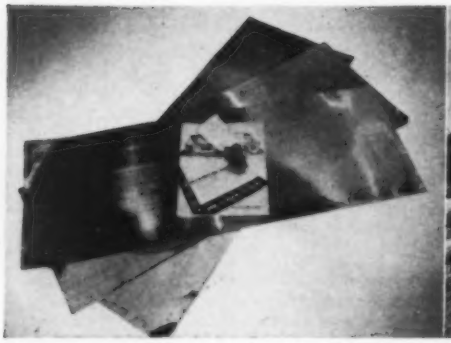
Heaviest wear on the bar usually occurs at the ends. The groove wears away at the center. You can check the bar with a micrometer or calipers.

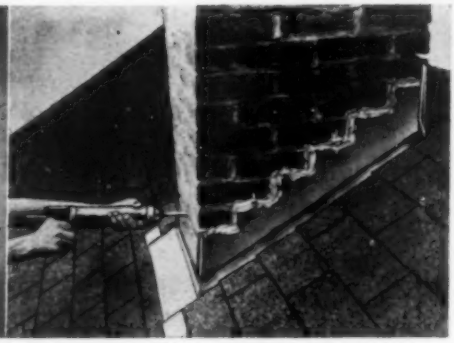
As the first reconditioning step, remove the head and hammer the ends of the bar for about 1½" until they are wider than the groove. In the drawing above, the hammered ends are exaggerated.

With a flat file, dress down the hammered edges until the bar fits the widest part of the groove, often at the near side of the table. Make certain the filed edges are parallel with the centerline of the bar. Chamfer the corners to prevent binding.

In most cases, this should complete the job. However, there are times when the bar is a snug sliding fit in part of the groove but binds elsewhere. In this case, dress down the narrow spots in the groove, using a flat file on edge. Finish the corners with a triangular file.

Try the fit of the bar frequently. When it slides freely, reassemble the head, adjust the stops, and you're ready to put the saw to work.—*Whitney K. Towers, Los Angeles.*





Flashing Material Offered in Handy Man's Package

MANY handy men hesitate to tackle the job of installing roof flashing. But Revere Copper and Brass, Inc., has just introduced a package of materials, complete with illustrated instructions, to show the ordinary home owner how to do this work at all vital points.

Priced at about $20, the package includes ten 18" by 48" copper sheets and 200 bronze nails. Two packages are said to contain sufficient material for the average house. The copper sheets are easily formed to any desired shape and nailed into place without special tools.

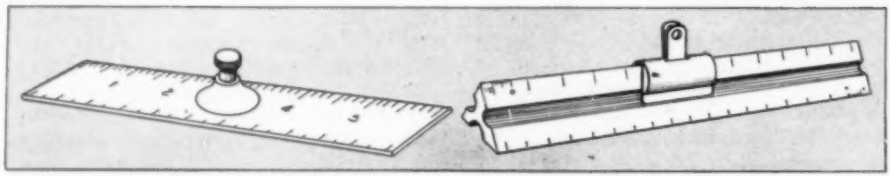
At the left above are some of the sheets. The 48" dimension was chosen as adequate for flashing the head of standard windows and doors. On the roof, the 18" width fills most valley requirements. Instructions include tips for making craftwork of scrap.

Plugs Protected with Plaster

VACUUM-CLEANER, toaster, and other frequently handled electric plugs are less subject to damage if the plug is filled with plaster of Paris. A bit of cloth stuffed around the cord opening will hold the plaster in the plug until it has set.—*R. F. Donovan, Jersey City.*

Clock Gear Substitutes as Saw

A CLOCK gear may be used in a drill press as a small saw. It's useful for cutting fine slots or kerfs in model work. The teeth can be filed sharp. Feed the work easily, making several light cuts to the required depth, against rotation.—*Herbert Pfister, Bronx, N. Y.*

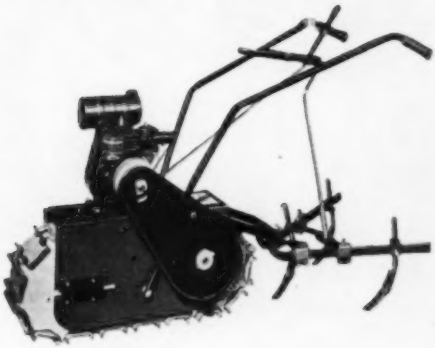


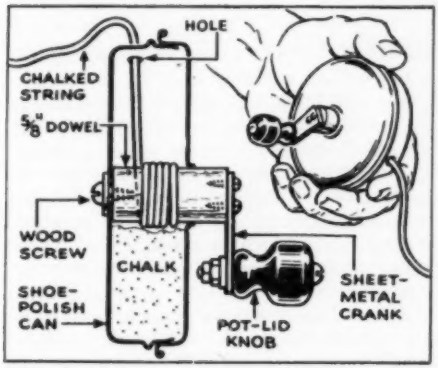
Paper Clip and Suction Cup Help You Use Ruler

Two ready-made conveniences for handling flat and triangular rulers are a small suction cup and a spring-type paper clip. Press a suction cup in the center of a flat ruler, and you can pick it up easily. Architects, engineers, and others using a triangular scale will find that the clip facilitates manipulation of the ruler and keeps the scale on the side being used.—*M. A. Jacobson, Chicago.*

Crawler-Type Tractor Moves Between the Rows

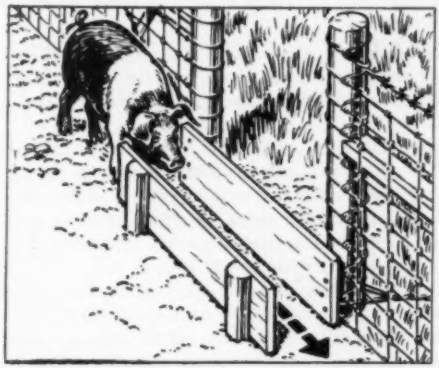
PROPELLED by a 1½-hp. gasoline engine, this caterpillar garden tractor has good traction on any type ground. Since it travels between the rows, instead of straddling them, the tractor can be used even after plants reach shoulder height. Although it weighs 230 lb., it is easily maneuverable. Gas, clutch, and cultivator controls are located on the handle bars. Cultivator teeth are adjustable from 9" to 24" width and to a maximum depth of 5". The revolving track is 7½" wide. The tractor is a product of the Gray Company, Inc., Minneapolis, Minn.





Polish Can Holds Chalk Line

AN EFFICIENT carpenter's chalking line may be made from a shoe-polish can. Drill the holes in the top and base of the can for the dowel and the wood screw. Cut a piece of sheet metal for the crank and use a pot-lid knob for a handle. Fasten an end of the string to the dowel with a small tack. Half fill the can with powdered chalk. The line is rechalked each time it is rewound.—*Roland Cueva, Manhattan, N. Y.*



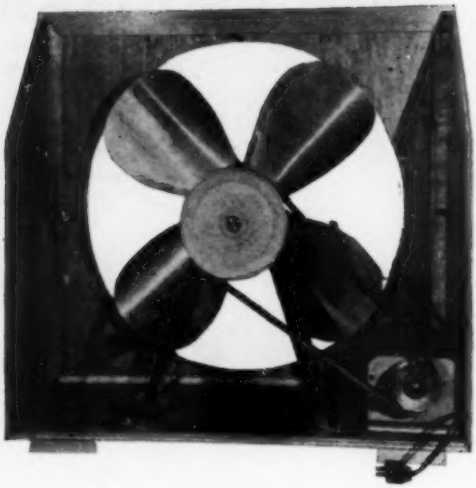
Board Blockade Fools the Pigs

A PIG'S life is a tough one. The grass always looks greener in another field—but what are pigs going to do when up against a contraption like this? They can walk between the boards, but there just isn't room to turn and head toward the places they're not supposed to be. Nor will they scramble over the boards, for they dislike scraping their bellies over an edge.—*Marion L. Rhodes, Knightstown, Ind.*

Water Pan Protected by Inverted Hamper

CHICKENS frequently overturn their water pans or scratch dirt into them. A simple guard for the water pans can be made from regular tomato hampers. Remove every other stave, sawing through the center hoop which is stapled to each stave. It is a good idea to place a weight, such as a rock, on top of the hamper to keep it from being overturned.

Homemade Exhaust Fans Beat the Heat



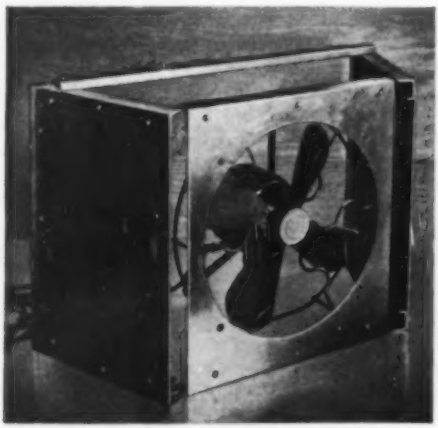
Whether you need just a little window ventilator or a husky attic fan, this article will give you plans and tips.

COOLING achieved by an exhaust fan is generally more satisfactory than cooling obtained with a table or floor fan. Instead of being a mere air stirrer, an exhaust fan works by replacing heated or contaminated air with cooler or fresher air.

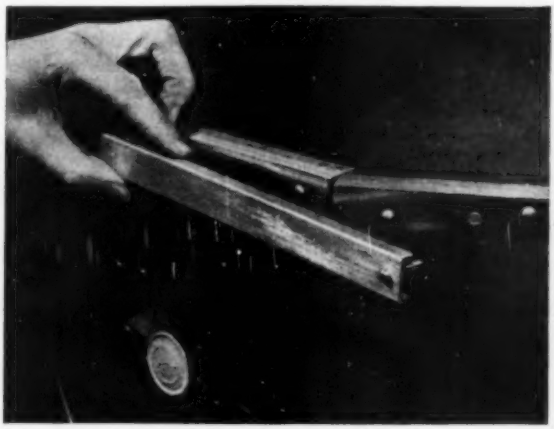
For cooling or ventilating a single room, an 8" to 12" fan installed as a window ventilator is often valuable. Ordinarily placed to discharge outward, it can be turned around to draw in outside air directly. Such a fan will be useful in a living room, bedroom, and kitchen; and it'll also be handy in the darkroom or workshop, especially during dusty operations or while painting.

The little window ventilator shown was built around a standard 9" table fan of long previous service. It's designed in three hinged sections, which makes it easy to install within the sash channel of a window casing.

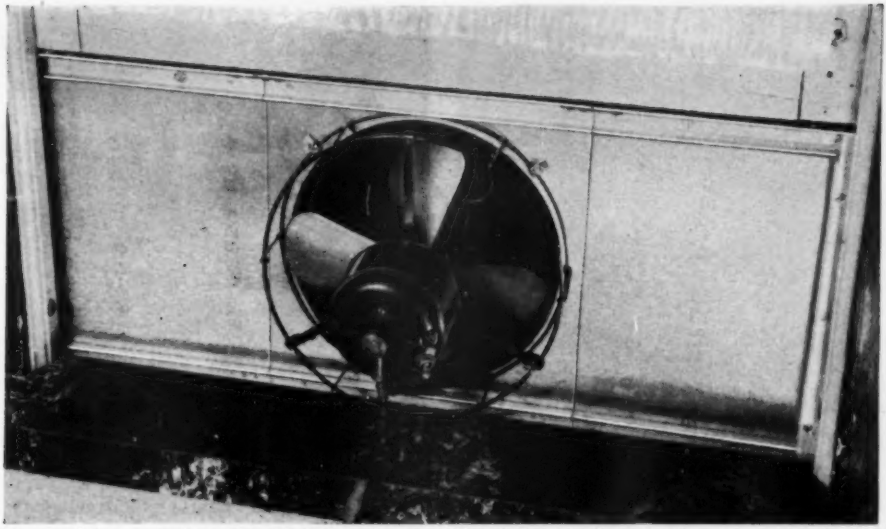
In working out your dimensions, make the overall length about ¼" less than the window recess so there'll be clearance for



With wings folded back, this window fan will support itself on a table for use in a room.



A length of channel held by wing nuts locks the three dural panels when fan is in a window.

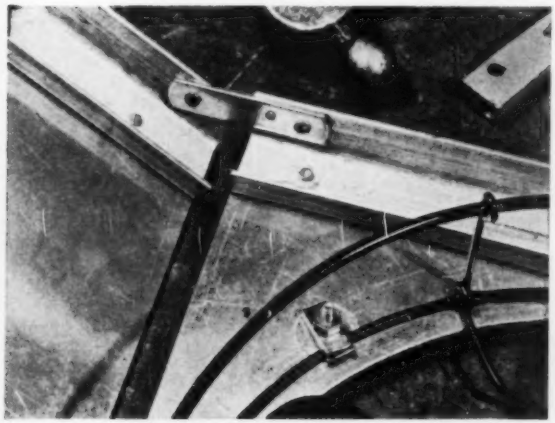


Mounted in a window, this 9" fan sucks out hot air and cooking or painting odors efficiently. If fitted with light baffles, it would also be handy for ventilating a small photo darkroom.

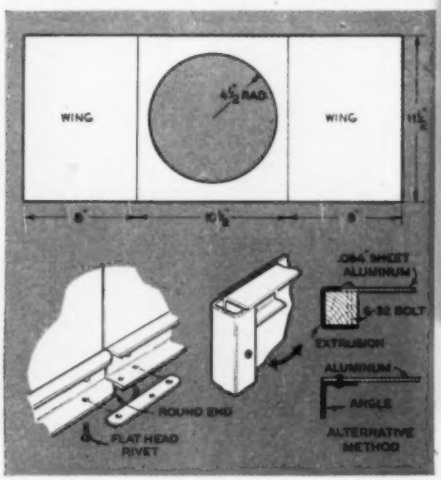
the wings to straighten. Also allow about ¾" on each side of the fan opening in the center section, and leave space above and below for the angle or channel. The opening, which can be cut neatly with a metal-working blade in a jigsaw, should be about the same as the fan-blade diameter. Screw-held brass clips hold the guard to the panel; most fan guards are strong enough to support the motor easily. The base is discarded.

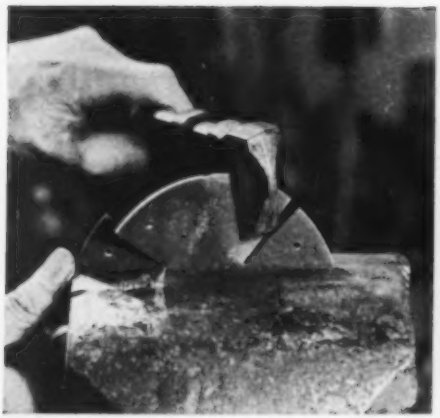
The panels are hinged through brass strips riveted to the channel. Two different methods of stiffening the ends of the wings, using channel or angle, are detailed in the drawing. A 17" length of channel fitted with a bolt near each end locks the ventilator in a window or with its wings bent.

Many variations on this basic ventilator are possible. It could be modified for semi-permanent installation at the top of a window. Or if its chief use is to draw in outside air directly, it could be fitted with a screen or air filter. Locating the blades within a little cowl or tunnel would prob-



A brass strip riveted within the channel takes the hinge pivot. Simple clips hold guard on.





Bent to give pitch, a 5" steel disk anchors the blades. It's drilled and slotted before bending.

Blades of .064" aluminum are carefully riveted to the disk. Note that the blades are dished.

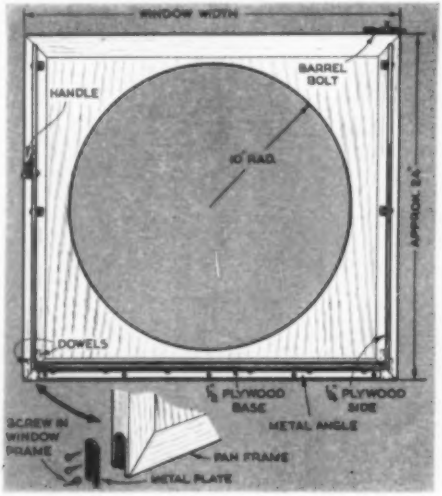
ably boost efficiency. And rubber mountings would cut noise to a minimum.

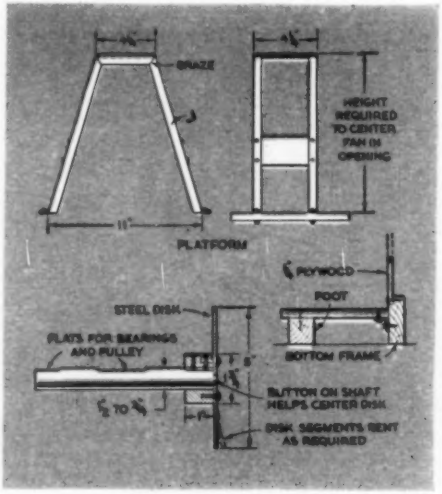
For cooling several rooms or even a small bungalow, the 20" belt-driven fan shown will do a fine job. It's designed to take full advantage of the maximum width of a standard window; and although portable it can be left in place for the season, since it doesn't interfere with the window.

A doweled hardwood framework, built like a sturdy picture frame, is constructed to a size that will just fit within the window casing. Cleats screwed to the casing prevent the frame from touching the sash. Two slotted metal plates engaging screws in the casing hold the bottom in place; and barrel bolts at the upper corners of the fan enter holes in the casing to secure the top. A rectangle of ¼" plywood with a 20" opening fits a rabbet in the frame and is held with glue and nails. A shelf at the bottom takes the motor and fan platform, while plywood sidepieces support a guard of ½" hardware cloth.

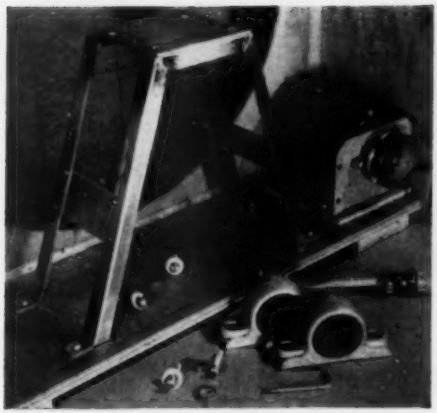
Mounted on a platform of bent and brazed steel angle, the fan shaft runs in a pair of ball bearings. Those shown, found in a surplus outlet at about $5 a pair, take a ¾" shaft; but a ½" shaft would do as well.

The fan blade proper can be purchased in a supply house, but isn't difficult to make if you have metal-working equipment. To





Doweled, glued joints secure the mitered hardwood frame, which is rabbeted for the plywood.



Light steel angle, bent and brazed, provides a strong platform without obstructing air flow.

duplicate it, cut a stiff steel disk 5″ across and scribe two diameters at 90 deg. Saw in along each line for 1½″, drill a center hole and blade-rivet holes, and then bend each segment to an identical angle.

Lay out a heavy-paper pattern for the blades, 10″ long, 7″ wide, and proportioned like a fat-ended paddle. Cut the four blades of .064″ aluminum, taking care to get them identical. Curve each of them as shown in one photo and rivet securely to the disk. For the hub use a lathe turning or a junk-box finding—perhaps a small, trued-up floor flange. Fasten on the blade assembly with steel bolts, using a "pip" turned on the end of the shaft to center the disk.

Revolve the fan slowly by hand, bending the blades so that the same point on each one describes precisely the same circle. Check for static balance by allowing the shaft to revolve on a pair of knife edges, correcting by filing the heavy side.

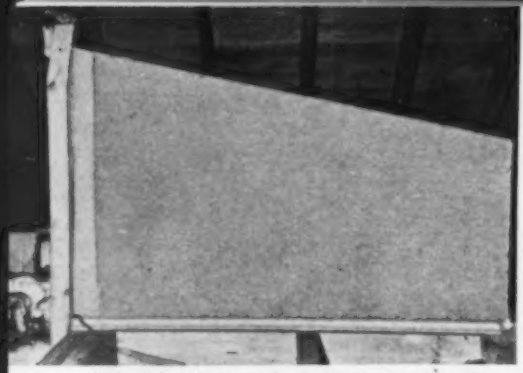
A motor mount slotted for adjusting belt tension is screwed to the shelf, and ½″ V-belt pulleys, sized to give a fan speed of about 600 r.p.m., are installed. The motor can be any constant-duty type rated at from 1/20 to 1/10 hp.

For an attic-type exhaust fan, you'll probably want a blade of greater diameter, driven by a 1/6- or ¼-hp. motor at a somewhat slower speed. If the attic is fairly airtight, especially around the eaves, the fan may be installed in a window or louvered grille. If it isn't tight, this isn't advisable since the fan may suck air in through the eaves rather than up from the lower floors.

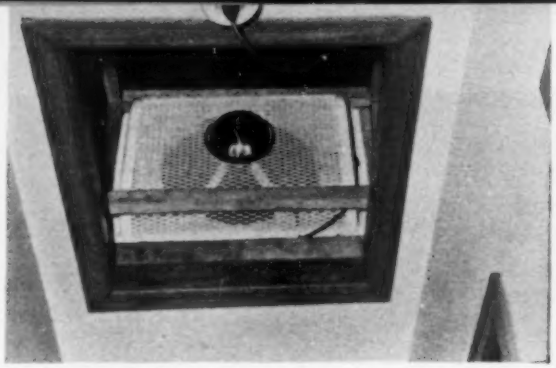
In cases like this it's best to put the fan

Ball-bearing pillow blocks are used. This ¾″ shaft is extra husky, but a ½″ shaft would do.

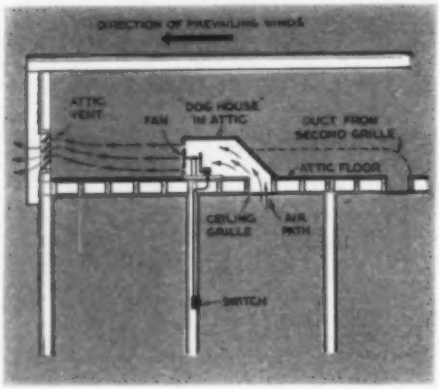
The finished job, pictured from the discharge side. Hand grips are convenient in moving it.



Attic "dog house" built by D. W. Hertel encloses exhaust fan. Its discharge is to the left.



As seen from below, the fan is mounted over an attic hatch in upstairs hallway of Hertel home.



in a "dog house" on the attic floor, discharging toward a window or louvers located downwind of the prevailing wind direction. The intake of the dog house is up through a ceiling grille. Two photos show such an installation built in his home by D. W. Hertel, of Cincinnati.

Attic fans, being designed to draw heated air up from the rooms below and to replace it with cooler outside air, are generally operated only at night. Therefore, since the fan is often used during sleeping hours, it should be vibration-free. Comparatively low blade speeds are preferable.

Though you can get along with a plain manual switch, automatic controls for an attic fan are a convenience. One method is to use a commercial time switch to turn on the fan an hour or so after sundown and to cut it off late at night. A further refinement is to put a cooling thermostat in the circuit, wiring it so that the fan will run only if the post-sundown temperature is above a set point. The thermostat, which can be homemade or purchased, will stop the fan when the temperature drops below a set point.

If you make your own, an ether-wafer unit of the kind used in poultry incubators will give you a good start. Mount it in a simple frame with its actuating stud tripping a snap-action switch. Leave a little springiness in the action so as to get a temperature differential at the critical point, or else the fan will start and stop repeatedly near it.—*Walter E. Burton, Akron, Ohio.*

Automatic controls increase the usefulness of exhaust fans. Disassembled at left is a homemade thermostat built around an ether wafer of the type used to control poultry-brooder heat. Center picture shows it assembled. At right, a time switch that will control fan's operation.

Water Toy Amuses Child

HERE is an action toy, operated by dripping water, to keep your baby contented in the bath. The duck can be made of light sheet metal, acetate film, or 1/16" plastic. It's mounted on a wire attached to a vacuum cup. Cut the figure as shown, making certain that the rear of the duck slightly overbalances the front part. Bend the upright piece projecting from the back to line up the two holes for the supporting wire. Give the beak a half twist so it presents a flat surface to the drops of water. Bend a loop in the end of the wire after passing it through the holes, and paint the duck in colors.—*Raymond DeBusk Jr., Muncie, Ind.*

Wire Brings Live Bait to Hand

IF YOU'VE wasted time and patience retrieving live minnows from a jar, you may want to try this arrangement to bring the small fish within reach. Pass a stiff piece of wire through a perforated can lid and through the top of the jar. Bend the wire beneath the lid as shown and just pull it up for fresh bait as and when you need it. —*Roland Cueva, New York City.*

Plastic Bobber Slides on Line

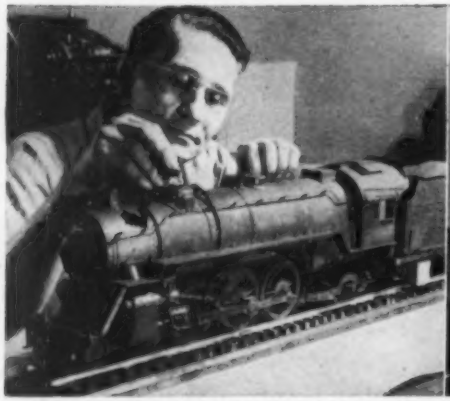
THE line snaps into retaining eyes on each end of this bobber and runs through a deep center groove. This allows the bobber to slide between the sinker and a knot of thread wound around the line, keeping the bait at the proper depth. If the bait hits bottom, the bobber lies on its side. Weighing only ⅜ oz., it is made of corrosion-proof Tenite Ⓣ by Namco Manufacturing Co., Minneapolis.

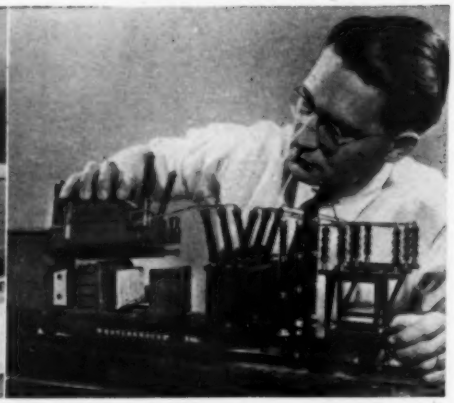
Sprinkler Reverses Itself

THIS rotary sprinkler is adjustable to cover circles from 15′ to 90′ in diameter. Pressing a reverse gear and setting the stop also causes it to swing back and forth through any part of a circle. In addition, it may be set to water a long narrow strip. Made by the Double Rotary Sprinkler Co., Kansas City, Mo., it sells for about $18.

Notched Cork Lets Air Escape

EVERYONE who uses those small bottles of India ink probably has seen excess air in the bottle push the cork out as soon as it was put in place. A small notch cut in the side of the cork, as shown in the drawing, permits excess air to escape. Thus the cork stays in.—*Raymond E. Haven, Monroe, Ohio.*





Chiropodist Modelmaker Turns Feet into Inches

For a living, Chiropodist Walter J. Teskey, of Pittsburgh, treats ailing feet. For relaxation, he produces working models of various machines, all to exact scale.

Two of his products are seen here. At the left is a model of a Baltimore & Ohio "President" locomotive. The engine and tender contain more than 4,000 parts, most of them machined in Dr. Teskey's tool-jammed home shop. It burns soft coal and gets up 125 lb. of steam.

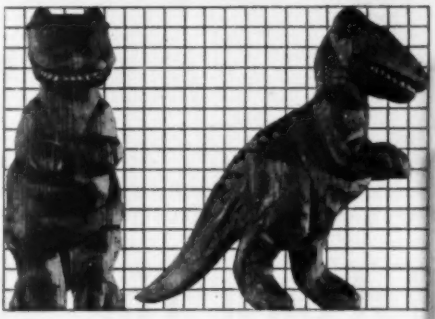
At the present time, the tender is minus its wheels and trucks. To save construction time, they were sacrificed to the model at the right—an electrical substation on a railroad car. This model was built on a rush order for the Westinghouse Electric Corporation. It guided engineers in the construction of full-size equipment designed to take power from transmission lines near railroads.

The doctor's latest model is a transformer, also built for Westinghouse. This required about 5,000 separate pieces.

Just Like Daddy's, Midget Tractor Is Boy's Toy

This junior-size tractor, driven by five-year-old Robert Scattini, is of all-welded construction. It was built by the boy's grandfather, J. J. King, of Salinas, Calif. Powered by a small air-cooled engine, it is equipped with a master clutch through which two belts drive a pair of flat sprockets. Tighteners on the belts act as steering clutches when released by pulling the steering levers. Either track may be locked by a foot-operated drag brake. The disk harrow is the type used with small garden tractors.

Miniature Dinosaur Guards Desk Pen



A JUNIOR version of Tyrannosaurus, largest of the flesh-eating dinosaurs, will guard your desk pen. You'll enjoy whittling this prehistoric nightmare down to pipe-dream size.

Lay out the figure on ¾" squares, using 2" stock. Although any softwood will serve, I find redwood carves easily. Regular carving tools are fine for this job, but even a penknife will do. Form the scales on the back with a small gouge if you have one. Sand lightly after carving but don't round off all the cuts.

Tyrannosaurus was a 38' long monster that walked on his huge hind legs. His distinguishing features were massive jaws and teeth nearly a foot long. So lend your carving an authentic and appropriately ferocious touch by emphasizing the teeth with white paint.

Use small, roundheaded tacks or escutcheon pins for the eyes. Set them high upon the head as in the photograph. Paint the lips and nostrils red to add realism.

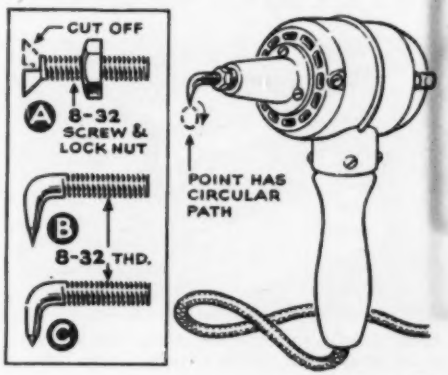
For the base, use any suitable ¾" stock. You may want to use a wood that will contrast with the figure. For example, maple will look well with redwood, or a walnut base with pine. It is an irregular oval about 7" long and 4½" wide. Rough-carve the sides as shown. The tree stump is 2" high and 2¼" in diameter at the base. First turn or whittle it to its general shape. Then carve the sides to resemble bark. Drill the hole in the top at about a 60-deg. angle.

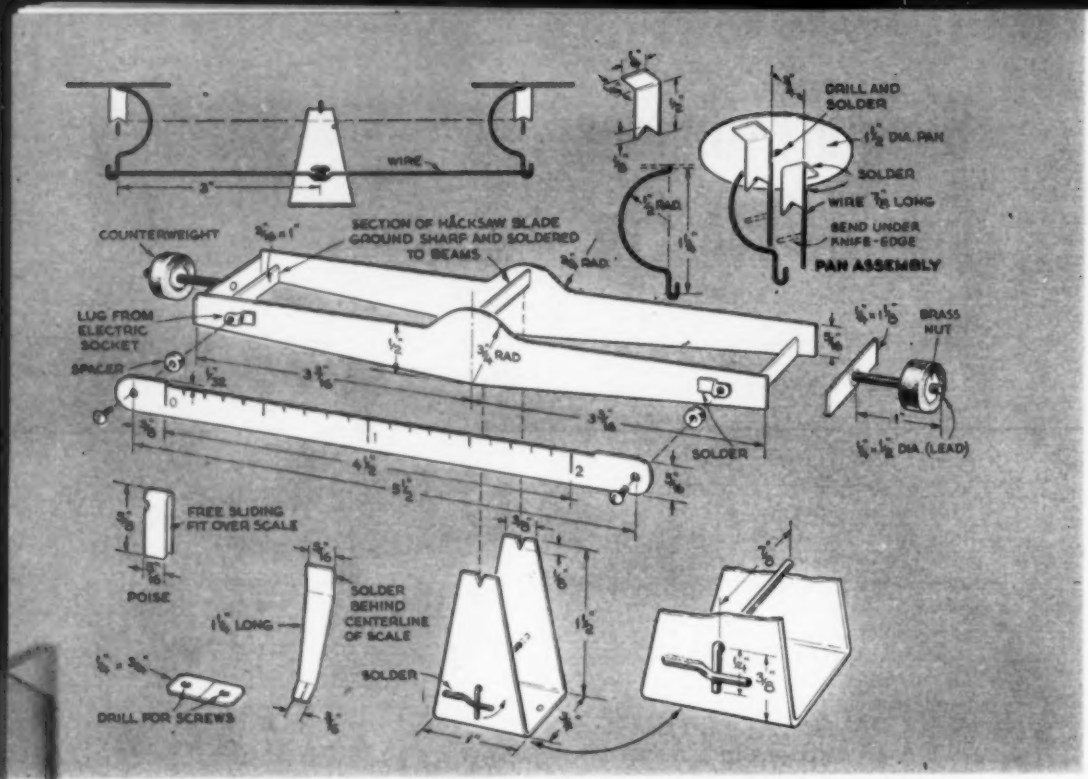
Darken the top of the base with stain or paint first. Then varnish or shellac all the parts. Fasten Tyrannosaurus and the stump to the base with glue and small screws. The pen is the type that may be bought without a base.—*Elma Waltner, Hurley, S. D.*

Vibrator Adapted as Engraver

AN ELECTRIC vibrator that has outlived its original usefulness may be converted to a carving and engraving tool. Remove the rubber vibrator head and replace it with a screw or with a piece of drill rod.

Cut the screw as shown at A for a wood-carving tool. Heat and bend the rod as at B and C for metal or plastic engraving. After grinding the points, harden and temper them. In operation this tool describes a 1/32" circle rather than the linear in-and-out motion of a commercial vibrator-type tool.—*Andrew Kovak, Bronx, N. Y.*

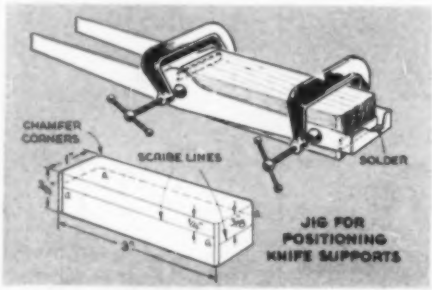




Sheet brass can be used for most of the parts. File down the top edge of the scale area.

Balance Tips at Half a Grain

SENSITIVE to ½ grain and direct reading to .1 gram, this chemical balance is entirely adequate for a home laboratory. Two sets of weights are used—one consisting of 1, 2, 5, 10, and 20 grams; and another of 1/16, ⅛, ¼, ½, and 1 oz. The beam frame, scale, stand, pans, pointer, poise, and pan pivots were all shaped from 1/32″ brass.

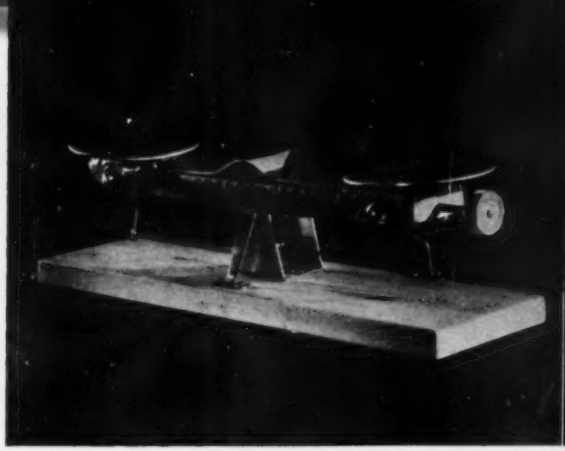


Align the jig so line *a-a* is even with the top of the frame. The middle support points down.

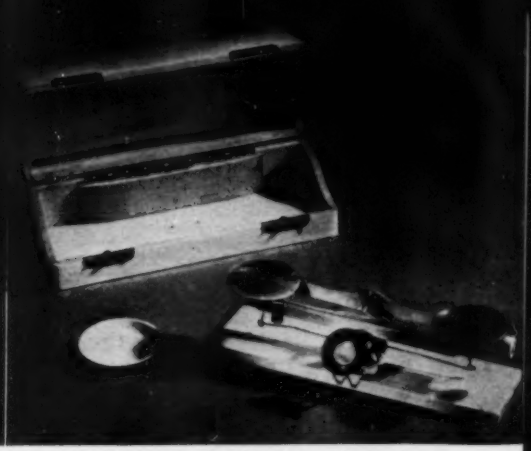
Knife supports were cut to size from an annealed hacksaw blade. The three sections were then retempered and finally ground and honed to a perfect edge. This edge should be smooth and in the center of the blade cross section. Mounting lugs and screws for attaching the scale may be obtained from an old electrical socket. The spacers came from a radio condenser.

Counterweights were made by threading a tinned brass nut on a brass rod, centering this assembly in a ½″ hole bored in scrap wood, and pouring in molten lead. The counterweights were then sanded smooth and painted black.

A wood jig, ¾″ by 1″ by 3″, is required for positioning the knife supports. Assemble so line *a-a* is flush with the top edge and one end at the exact center of the beam. Point



Mount the parts on a base. Place on a level surface when in use. A case (right) is desirable.



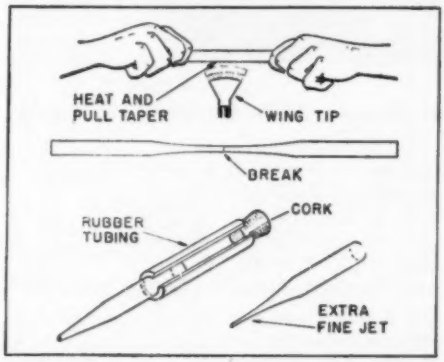
A magnifying glass helps bring the scale to exact balance. A wire frame supports the glass.

the middle knife down and align the sharp edge with the part of *a-a* carried around the end. Position the end knives with the sharp edge up, even with the ⅜″ line.

Screw the scale to a block of wood, exactly parallel to one edge. Then use a square to scribe true lines at both ends of the 4½″ scale area. Now use dividers, cutting the 4½″ distance in half and then dividing the halves. Finally, divide each of the four spaces into five equal parts. Each one of the 20 equal spaces then represents .1 gram.

After the scale has been mounted, place it on a level surface. With the poise at zero, bring the scale to balance with the counterweights. Place a 2-gram weight on the left pan and move the poise to the 2-gram mark. If the pointer is deflected, the poise is heavy. File off a little at the bottom and again start from zero. Continue this try-and-file method until the poise is the correct weight.

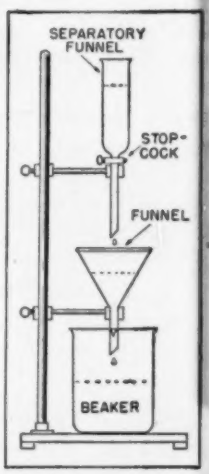
Weights were made in this instance by filing down pieces of brass strips until they matched known weights. The brass weights ranged from 1/16″ to ¼″ thick. It's easier to make weights of bar solder. You'll also need a shallow pan and a counterweight for it.—*J. A. Appelquest, Leonia, N. J.*



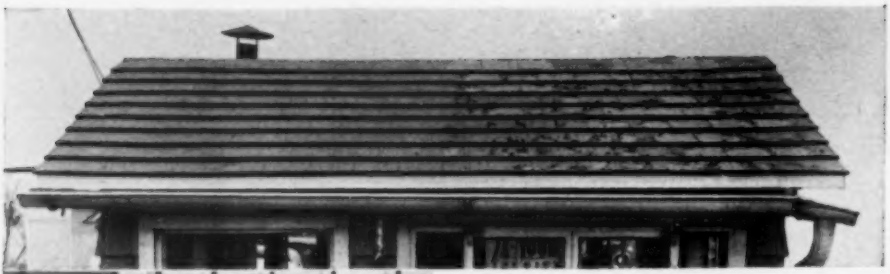
Droppers Made from Tubing

Glass and rubber tubing and a suitable cork are all you need to produce a useful laboratory dropper. Heat the glass over a wing top on a Bunsen burner, draw it out, and break off. For a fine jet, draw it almost to a thread.—*Jo Ro Jung, New Orleans.*

Second Funnel Saves You Time



Two funnels are better than one when you are filtering a solution in the laboratory. They'll let you save your attention for some other job. Mount a separatory funnel above the regular filtering funnel, as illustrated in the sketch. Fill both funnels with the solution and adjust the stopcock so that the liquid drops from the top one at the same rate as it leaves the bottom one. This setup filters twice as much per filling as one funnel would.—*Kenneth Knauss, Allentown, Pa.*



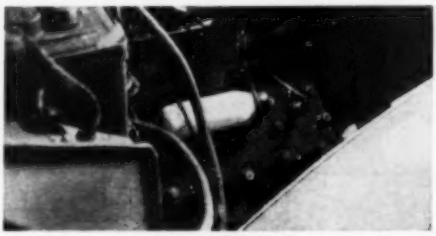
Paint Holds on Galvanized Iron

SATISFACTORY application of paint to galvanized iron has long been a problem. If the surface isn't prepared first, a reaction is set up that causes the paint to peel. Various treatments have been used from time to time, among them a vinegar wash.

The American Chemical Paint Co., of Ambler, Pa., has now introduced a solution called Lithoform ® that is said to anchor the paint. Applied with a brush before painting as at left, it forms a stonelike zinc phosphate coating to bond the paint to the metal. In the upper photo, it was used on half the roof. Right half was untreated.

Car Engine Heats Baby's Bottle

IF YOU travel by automobile with a baby, here's a method of eliminating roadside stops to heat bottles. Use engine heat. The photo shows a bottle slipped under the ignition wires of my car. There's enough tension to keep it there while driving. The milk heats to proper temperature in 20 minutes.—*D. E. Zook, Lt. Comdr., U. S. N.*

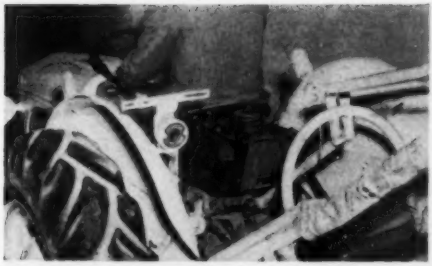


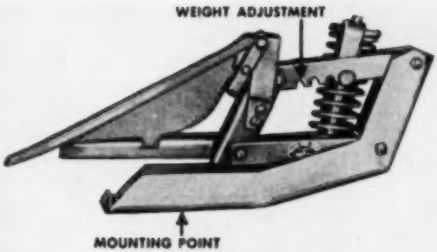
Wire Holder Protects Bristles

BENT to an L-shape, a piece of wire provides an excellent means of suspending a brush in a tall bottle. It keeps the bristles from resting on the bottom and spreading. No. 9 wire is a good size. Slip the short end into a hole bored in the brush handle. The long leg should extend beyond the bristles. – *Benj. Nielsen, Aurora, Neb.*

Beeswax Aids Driving of Nails

I HAD to drive a number of nails and screws into hardwood and, in some places, into knots. More often than not, the nails would bend, and it was almost impossible to drive the screws. Beeswax rubbed on the points helped. A convenient carrier for the wax is a ⅜" hole drilled 2" into the hammer handle.—*George J. Polak, San Pedro, Calif.*





Hydraulic Tractor Seat Features Weight Adjuster

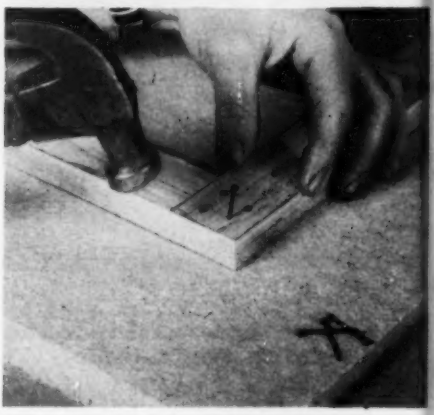
THIS tractor seat has an airplane-type, hydraulic shock absorber inside the spring to control the action and prevent rebound pitch. The seat is quickly changed to accommodate a 75-lb. boy or a 300-lb. man, simply by shifting the spring assembly into different notches. This varies the leverage. Easily mounted on any tractor, the seat is produced by Knoedler Manufacturers, of Streator, Ill.

Can Supports Pot for Painting

WHILE painting a flower pot, you can keep paint off your fingers by pressing the pot down over an ordinary tin can as in the photo at right. Leave the pot on the can to dry. Thus the surface will not be marred by premature handling.

Milking Stool Also Holds Pail

HERE's something to keep your cow from kicking over the milk bucket—a combination stool and pail-holder. It was put together with a few boards and a piece of heavy wire. The pail rests on a horizontal member that projects from the solid front leg. Drill holes to take the wire. Then insert wood screws from underneath to meet the wire holes. The screws will hold the wire.—*Marion L. Rhodes, Knightstown, Ind.*



Insulating Board Saves Bench

WHEN you're assembling material with clinched nails, a sheet of soft insulating board at least ½" thick will make the job easier and prevent damage to your workbench. Place the work on the board and drive the nails into it. You can then pry the work from the board, turn it over, and quickly clinch the protruding nails on a metal plate, anvil, or upended flatiron.—*R. O. Lissaman, Brandon, Man.*

Plywood Kitchen Eases Camp Work

ROADSIDE campers who favor at least a few home comforts will appreciate this compact, all-plywood camp kitchen. It's easily carried in most luggage compartments.

All of the outer faces and the main vertical partition are ½" stock. Other parts are of ¼" plywood. You can tailor the size of the various compartments to your own camping needs. Vertical partitions are dadoed for the horizontal panels, which are staggered to avoid weakening the upright pieces. Double lap joints along the outer edges insure sturdy construction.

Instead of being hinged in place, the front panel is removable for use as a table top or bread board. When closed, it is held in place by two hooks at each side. Handles are attached at each end and the top will accommodate an average gasoline stove.

The bread compartment at lower right is hinged at the bottom and has a spring-button catch at the top. This compartment is 6" high and 13" wide. Ample provisions for several meals along the road can be stored in the other spaces and drawers. Finish with varnish.—*Edward R. Lucas, Poulsbo, Wash.*

Old Candle Stubs Cast to Make Long-Lasting Big Candle

SAVE those burned-down pieces of candles. By remelting them you can make one big, stubby candle for lights-out emergencies or for use in the summer cottage. Tie a big nail to a piece of thick, soft cord, which will serve for the wick. Drop the nail into an empty can, securing the cord with a stick laid across the top. Center the wick in the can. Melt the candle stubs and pour in the wax. When the wax has hardened, the big candle may be pulled from the can by the top stick. If it sticks, dip the can in hot water.—*E. Handleman, Portland, Me.*

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10	5" or 6" EXTRA SLIM TAPER

In filing a handsaw, two things are important toward making it "zing" through the wood true and fast: The file must be the *right size* and a *good brand*. The table above tells you about the sizes. The trade-marks below tell you the brands widely considered *best in the world*.

Count the teeth per inch in your handsaws, band saws, miter saws; take the table with you to your hardware dealer; ask for Nicholson or Black Diamond brand — and equip yourself with the most efficient saw-sharpening files you've ever used! *Free booklet*, "File Filosophy," tells about saw filing and about files in general.

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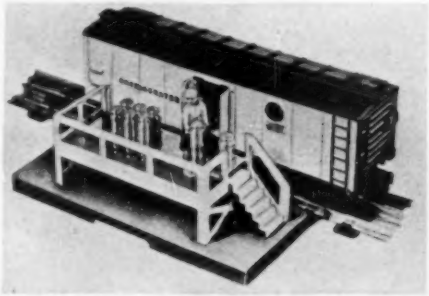

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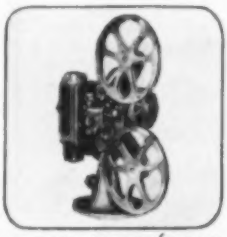

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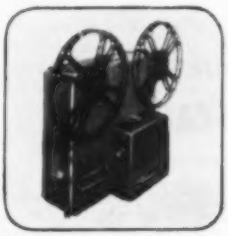

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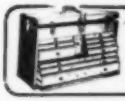

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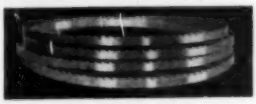

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PAINTERS' STRIPING TOOL

NOW you can do your own expert striping on furniture, bikes, model planes, bulletins, autos, toys, signs, linoleum, wall board . . . make plain walls look like tile! It's easy to paint straight, curved, circular, even parallel lines with any color. Handiest paint tool in your workshop! Type "M" Master Painters' Striping Tool complete with tip for 1/16" stripe, $1.00. Extra tips 1/64", 1/32", 3/64", 1/16", 5/64", 3/32", 1/8"—75c each. Tool with complete set of 7 tips $5.00. (C.O.D. orders 25c extra.) WENDELL MFG. CO., 4234—A Lincoln Ave., Chicago 18, Ill.

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Multi-Tool is the portable, self-contained, power source that will drive a wide range of machines and shop tools. Controlled speed range of 100 to nearly 10,000 r.p.m. is available on pulley-and-belt drive, and 1,600 to 2,600 r.p.m. on direct drive. Any machine or tool needing up to 1½ h.p. can be driven by Multi-Tool. Write for literature. See how Multi-Tool will save you time, money, labor.

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Simply take Multi-Tool to the job — wherever it is. ONE Multi-Tool will run dozens of different machines — cut equipment costs — eliminate drudgery. Use it for grinding, drilling, sawing, and for running feed grinders, corn shellers, cement mixers, forges and dozens of other uses.

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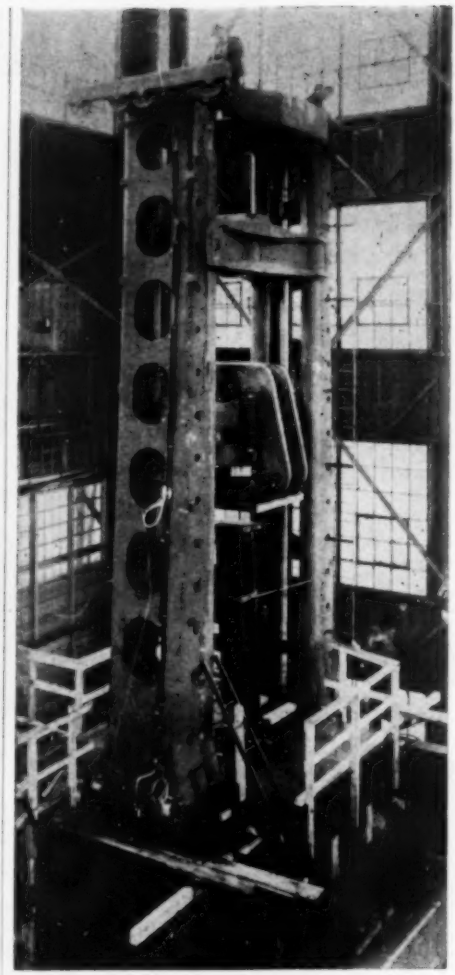


Thousand-Ton Squeeze

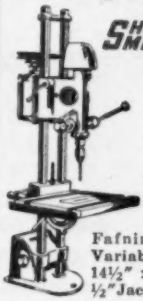
WEIGHING 300,000 pounds and capable of exerting a force of 2,000,000 pounds, the giant press shown above is considered the most advanced hydraulic testing machine ever built. Made by the Baldwin Locomotive Works, it is in operation at the University of Washington's structural research laboratory. The machine will take specimens up to 10 feet wide and 80 feet long, and is used for tension and compression as well as for transverse testing. Several new features in the design make the steel columns more rigid than has been possible up to now, giving the machine greater accuracy and versatility. It will be used in special testing research for industries in the Northwest.

NEW FIVE-IN-ONE *SHOPSMITH* OUTWORKS SINGLE PURPOSE POWER TOOLS

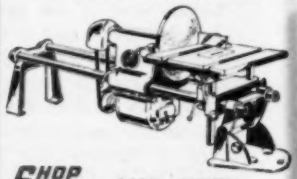
SHOPSMITH AS CIRCULAR SAW Has maximum distance of 46" between blade and fence. Tilts to any angle—positive lock. New principle provides micro-adjustment of distance between fence and saw blade. *Specifications:* Saw Blade: 8" Dia. Depth of cut 2¼". Table: 14½" x 17"; with extension, 54" x 17". *Equipment:* 8" saw blade and arbor. Table extension. Mitre gauge. Rip fence. Saw guard.

COMPLETE FIVE-IN-ONE TOOL $159.50

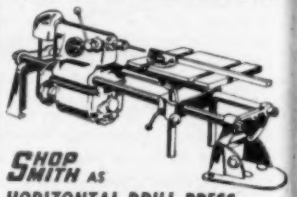
With special ½ H.P. ball bearing motor, $195.50



SHOPSMITH AS VERTICAL DRILL PRESS
Capacity: Drills to center of 15" circle. Clearance: Table to chuck — 27" max. Spindle: ⅝" Dia., 6 spline, hardened tip. Spindle Feed: 4¼". 4 grease-sealed Fafnir ball bearings. Variable speeds. Table: 14½" x 17". *Equipment:* ½" Jacobs key chuck. Fence.



SHOPSMITH AS DISC SANDER
Disc Diameter: 12". Table Dimensions: 14½" x 17". Tilting Table. *Equipment:* 12" disc. Mitre gauge.



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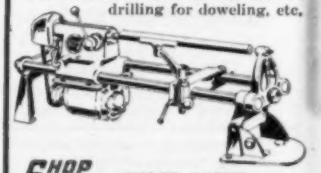
Only Shopsmith performs this highly useful function. No limit to length of work. Provides accurate method of drilling for doweling, etc.



SHOPSMITH AS WOOD LATHE
34" between centers. Swing: 15". Variable speeds. Quill Feed: 4¼". Equipment: Tool rest. Drive center. Dead center.

Shopsmith Brings You Five Sturdy Tools—Circular Saw—Wood Lathe—Disc Sander—Horizontal And Vertical Drill Press—All Engineered Into One Space-Saving Unit—59" Long By 21" Wide

WITH SHOPSMITH you get the *five* basic tools shown here—also convertible to grinder, buffer, router, drum sander, shaper, scratch brusher. And you can change from tool to tool *in less than one minute.* Each tool is . . .

BUILT RUGGED

Has cast iron headstock and carriage. Centerless ground and polished steel ways. Heavily reinforced table. Four life-long grease-sealed Fafnir ball bearings. Weighs over 200 pounds.

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"Dead-Locker"®

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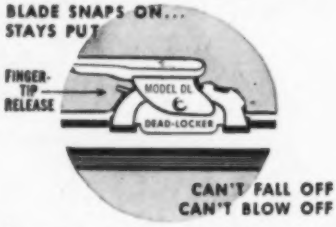

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SINGLES, Chev., V-8, Plymouth, Steels $5.50, Aluminum $7.00. Chry., Olds., Buicks, etc., Steels $7.50, Aluminum $9.00. V-8 and MERCURY DUALS, Steel $17.50, Aluminum $21.00. Split Manifold Sets, Steels $35.00, Aluminum $45.00. Aluminums are guaranteed for life of your car.

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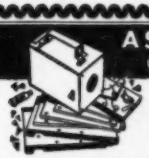

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Needs No "Fitting"

New Radionic Zenith "75"

This is all you wear. $75 complete.

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Coupon below brings it to you—no salesman, no visits to salesrooms. Hear better or pay nothing!

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**Plus tax of $1.50 in Illinois or New York City; $1.88 in California, except Los Angeles, $2.25.*

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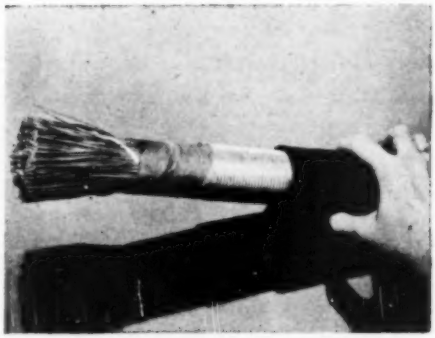

Shields Phone Cables

A NEW cable sheathing has been developed by the Bell System to help end the phone shortage. Lead, the usual cable sheathing, is scarce, so the new sheathing is made of aluminum and polyethylene plastic. It is to be used in local exchange areas on pole lines and in underground conduits. Cutaway section in photo shows, from left to right: wiring, paper binding, aluminum sheeting, and covering.

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1½-2 H.P. MODEL 700A	$59.50	Rope starter, direct drive models 1200 to 3600 r.p.m. for power tools, lawn mowers, air compressors, wood saws, etc.
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Center with No. 2 taper shank **$11.50**
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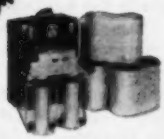

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(Add 35c ea. pr. to cover postage and handling.)

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— Sizes —
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Minimum order - 3 pair

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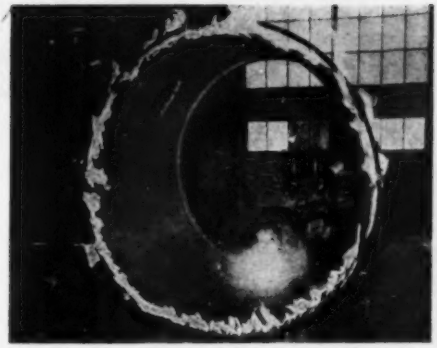

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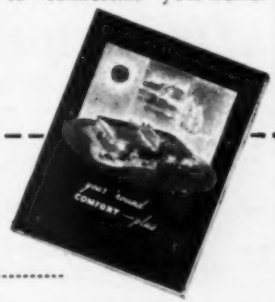

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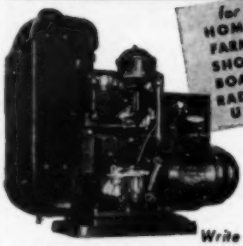

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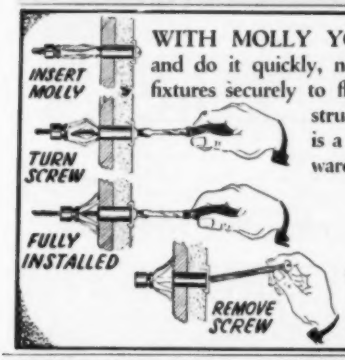

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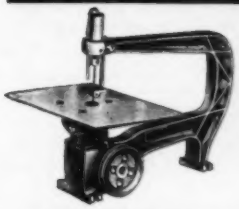

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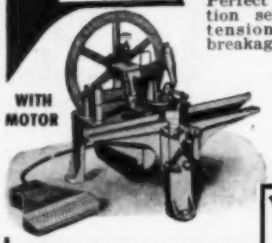

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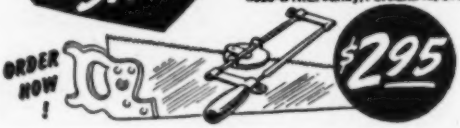

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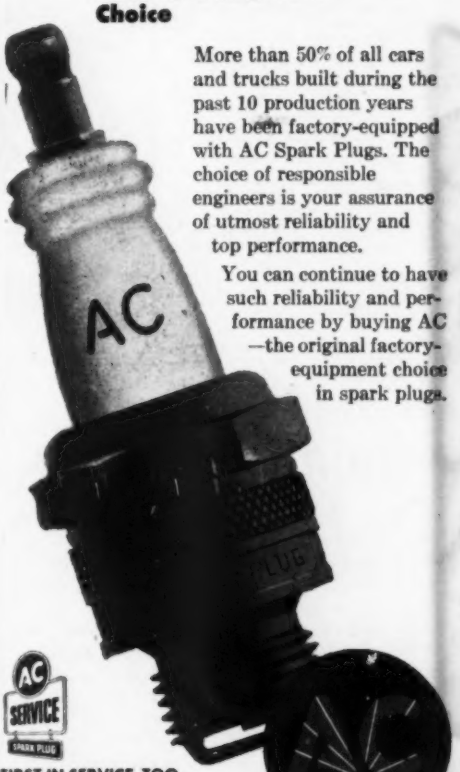

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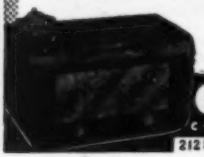

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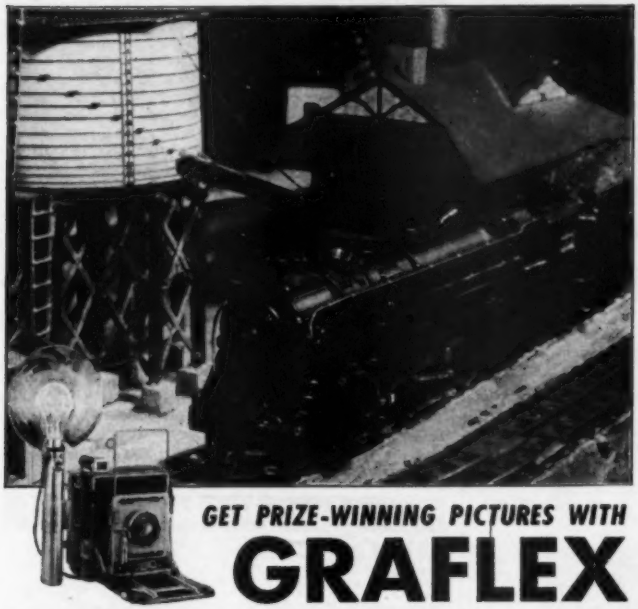

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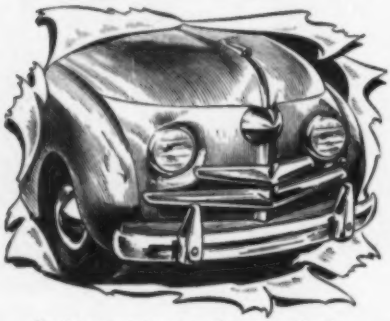

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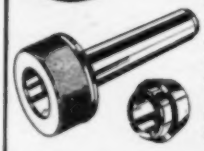

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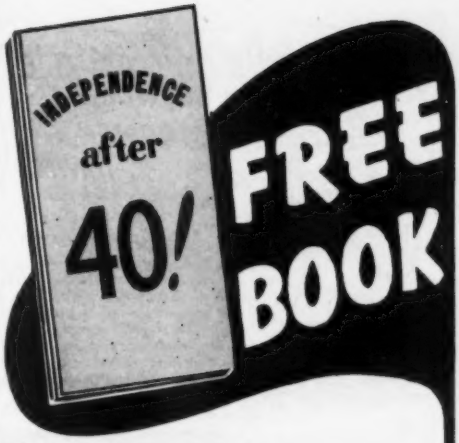

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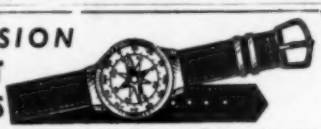

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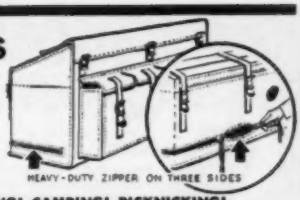

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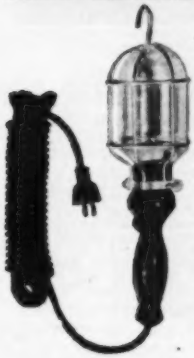

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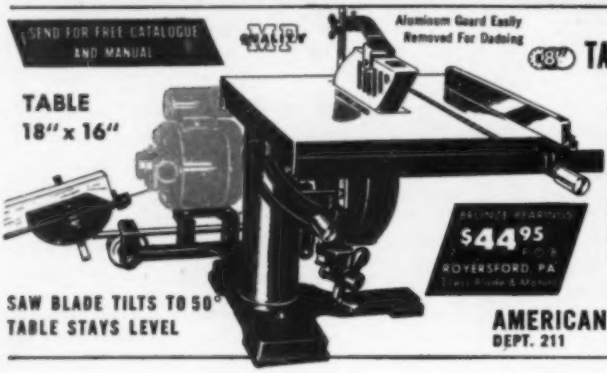

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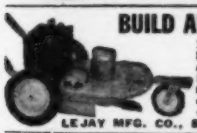

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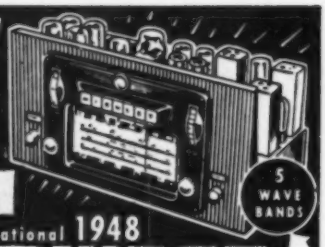

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Only $5.85 (with 3 Saw Blades) Postpaid

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Save More Than 1/2 Regular Cost

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Complete Optics!
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We supply Full Instructions

METAL PARTS—Set includes all Metal Parts—completely finished—for assembly of 7 X 50 Binoculars. No machining required. Bodies have been factory hinged and covered. A sturdy Binocular Carrying Case is optional with each set of Metal Parts.

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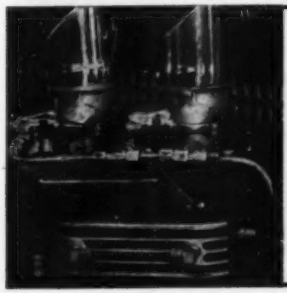

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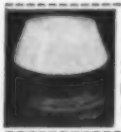

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ACTUAL SIZE

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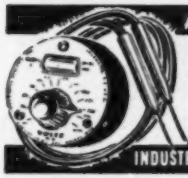

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Everything complete: 2 sturdy, steel, molded rubber tired wheels, bright red baked enamel finish; 2 steel brackets; 1 steel yoke, welded axle; rustproof; plated steel nuts; easy to assemble, complete instructions. Stands up to 1000 lb. load.

Send Check or money order. Shipments F.O.B. Cleveland 9, Ohio.

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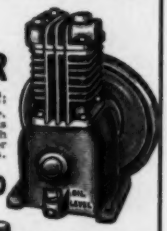
PISTON TYPE AIR COMPRESSOR



Piston type, size 2 x 1¾, head in valves, bronze bearings, splash lubrication, "V" Belt drive, intake muffler and cleaner. Capacity 2.8 c.f.m. at 100 lbs. continuous pressure or 150 lbs. Intermittent, with ½ HP motor. Can be used with ¼ HP or ⅓ HP at lower speed. Weight 14 lbs. Operating instructions furnished.

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¼" REDUCING VALVE & GAUGE

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Has a close range of closing after pop-off pressure is reached. ¼" pipe thread. Only..... **$1.50**

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Prevent leakage after compressor stops.

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AUTOMATIC PRESSURE SWITCH WITH UNLOADER

125-150 lb. pressure. Uses ¼ to 5 H.P. unit

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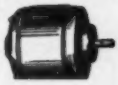

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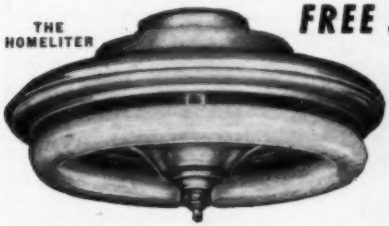

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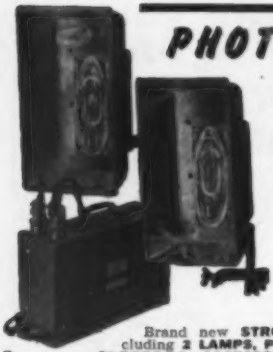

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Brand new **STROBOFLASH KIT**, including **2 LAMPS, POWER SUPPLY, REFLECTORS, ACCESSORIES and COMPLETE INSTRUCTIONS** for immediate 12-volt DC operation or 110-volt AC conversion. Yours for ONLY **$59.50**

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PLUS aluminum reflectors, transformer, connectors, cabling, instructions and 110-volt AC conversion price.)

Strobe-Lamps with reflectors ea. ..... **$10.95, 2 for $21.00**
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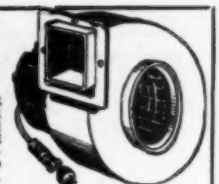

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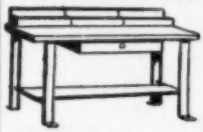

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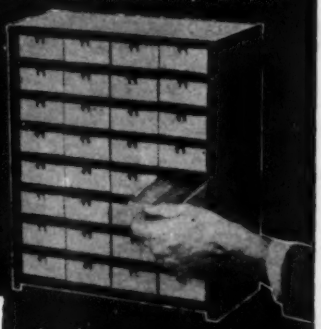

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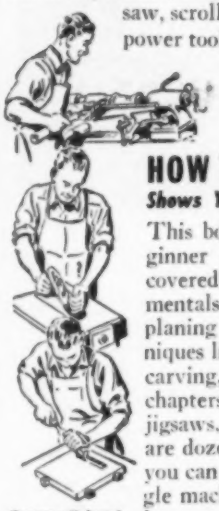

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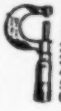

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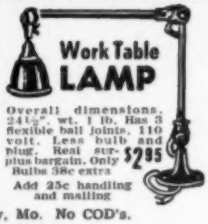

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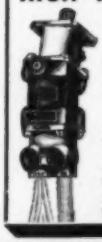

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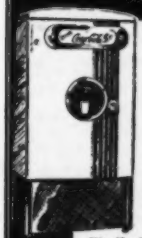

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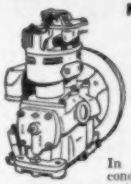

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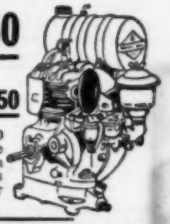

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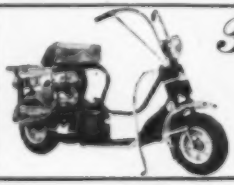

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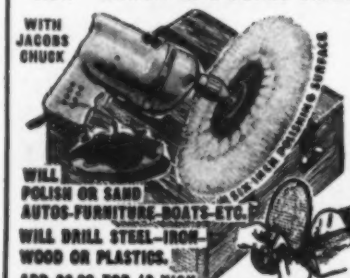

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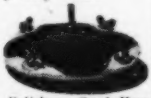

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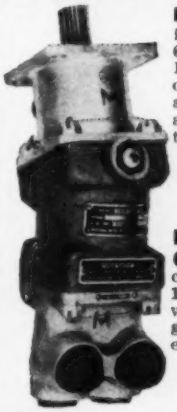

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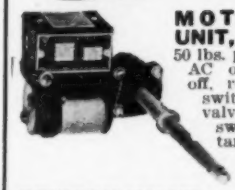

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Direct Current Generator, especially suited for adaptation to homemade welding unit.
A fast moving item at **$15.95**
P-1 GENERATOR 200 AMP **$22.50** ea.
R-1 GENERATOR 300 AMPS. **$29.50** ea.

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Needle, ball and roller bearings in excellent assortment. Sizes from 1/2" to 2".
#170 Introducing this treasure chest assortment of 15 Bearings at **$2.95**

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Torsion, compression and tension springs. Assorted sizes. #206
2 lbs. 89c
A treasure chest for emergencies!

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50 ft. ¼" Alloyed steel Cable with hook, shackled; Frame 14" x 18"; Bakelite handle; Worm; 1100 Value; 1" O.D. Alloyed steel tubular frame for versatile attachment; Cable guide roller pulley for low spring strain.
now equipped with mounting frame, handle, cable, etc. complete.
Thousands of Satisfied Users! Hundreds have written, telling us it's the most wonderful tool in the world!
Capacity 2500 lbs. 20-1 ratio
Bronze Worm Gear
Ideal for Garages, Truck loading, Machine Shops, Boat Builders, etc.
Same as elsewhere qdy. at $26.00. Our Price **$15.50**

Here's a Real "Lite Special"

Farm, Auto, New U. S. Navy Portable Pistol Grip, Sealed Beam, 12v. Search Spot or Emergency. Light-featherweight Gov. Cost $35.00 our price
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110 V. A. C. 13 ft. wire with socket, switch and plug. In mounting bracket suitable for home or workshop. Wire alone worth our price of 99c each.

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3 run 27 Volt motor $1.00
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115 ——— 30" 69c ea.
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Radio tuning shafts that can be used as flex gear drives. #115c 12 ft. ¼" nut —15 tooth internal spline $1.95 ea.
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NEW NICHOLSON & KEARNEY & TOOTE CO.
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An Unequalled Value!
GADGET MIX
Rivets, spacers, clamps, bolts, nuts, Radio parts, gears, etc.
A gold mine ..... 5 lbs. #100 **$1.19**

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Overall Width	Length	Price
1¼" (⅝ side)	72" alum.	$1.00 ea.
2" (1" side)	72" alum.	$1.19 ea.
1½" (¾" side)	53" cad. steel	.75 ea.
3½" (1¾" side)	33" steel	$1.00 ea.

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Eddie Lux Co2 Type. Built to Gov't. spec. 5½ lb. wrinkened shatterproof heavy case 20" x 6". Trigger controlled with horn, fully recharged. 6T8 Type.
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5 gal. gas or oil, self-locking screw cup type 18" x 6¼" x 12" Wide **$1.19** ea.
In lots of 5 **$1.09** ea.
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Self locking, flexible screw spouts with brass filter at end. 1" I. D. x 16" lg. **39c**

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#500 new ½ H.P. 27 Volt D. C. 24 Volt A. C. This motor can be readily adapted to 110 A. C. by the simple method of rearranging armature brush leads. We furnish free diagram of instructions with each order. A Sensational Value @ **$5.95**
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1 16 H. P., 24 Volt D. C. Motor, Series Wound. New. #501 **$3.95** ea.
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COMPRESSOR 1000 lb. pr., 2 stg. with ½ H. P. 27 V., D. C. motor, Tank and Fitting **$17.95**

4 INCH PAINTERS DUSTER BRUSH

Only **59c** ea.

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Side cutting beveled head a $3.50 Value Only **$1.79**

PLASTIC MALLET

clear, with 2" dia. 24" lg. head, 12" handle, for soft metal or plastic work where hammer-marking or tapping is desired. A $2.50 Value for Only **79c** ea.

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Compound action. Hard steel blades. Expansion spring. Locking device. Right Hand and Left Hand **$2.99**

PLASTIC PARALLEL STRAIGHT EDGE

with hooks and rubber pads for non slippage on each surface. A must for surveyors, mechanics, draftsmen, engineers . . . You've never seen 'em at **97c** ea.

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10,000 in various popular makes, sizes, types. Cleco, Aro, Ingersol Rand, Chicago, Pneumatic, Buckeye, etc.

RIVET GUNS
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with ¼" JCB Chuck Straight **$12.95**

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$12.50
With Terry Adapter ea.

CHI. PNU. IMPACT WRENCH

$17.50
Model 337rs 3/8" sq. dr. fwrd. & revrs. 6 spd. cntrl.
Send for Catalogue and List of Other Sizes, Types of Pneumatic Tools.

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New. Will hold up to 3,000 lbs. PSI. with Co2 used as tire inflator or fire extinguisher, with oxygen for sick room or deep-water diving, etc. Completely equipped with brass valve, 36" hose, dial gauge, & canvas bag ..... **$2.29** ea.

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50 pcs. including honing stone, pencil rolls, wheels, abrasive sheets, etc. A Real Value for Only **99c**

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12 pairs of strap butt Hinges, sizes 1" x 1" to 1½" x 4" in length, to 8" strap.
A $3.00 Value for Only **$1.09**

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Alloyed steel, rust resistant. 1/16" dia. 18 ft. long, with turnbuckle ends. On reels in any length **99c** ea.

1/16"	3c ft.	5/32	5c ft.
3/32	4c ft.	3/16	6c ft.
1/8	4¼c ft.	9/32	8c ft.

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Item #329 is textured rubber sheet with cloth center. Flexible but very fine for key, wear.

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TO: Reader
FROM: Editor

They Dreamed about Atoms

BECAUSE a dream of theirs is coming true, some of the country's leading physicists are walking on air.

One of them is Prof. E. O. Lawrence of the University of California, inventor of the cyclotron and America's No. 1 atom smasher. Another is his former co-worker, Dr. M. Stanley Livingston, who now heads the Accelerator Project at Brookhaven National Laboratory, Upton, N. Y. Last January, POPULAR SCIENCE told of their dream.

They and their research teams envisioned a ring-shaped atom-smashing engine so gigantic that even the great 184-inch cyclotron of the University of California would be a toy beside it. It would have a power of billions, instead of millions, of electron volts. It would need the most secure anchorage to keep the energy surging through its ring magnet from tearing it loose from its foundations. Its sound effects would out-Hollywood Hollywood.

This mighty tool would enable the physicists to probe, at last, some of the innermost secrets of the atom—the explanation of the "glue" that holds its nucleus together, the nature of mesons and other subatomic particles still cloaked in mystery. It would permit much larger scale experiments with man-made mesons, recently created artificially for the first time in the University of California cyclotron. Its revelations might lay the groundwork for the next great discoveries in an atomic age that has already given us the A-bomb, "artificial radium" to cure disease, and the promise of power from uranium piles.

Since POPULAR SCIENCE's article was published, the U. S. Atomic Energy Commission has announced that it will finance the construction, not only of one, but of two such machines—one at the University of California and the other at Brookhaven.

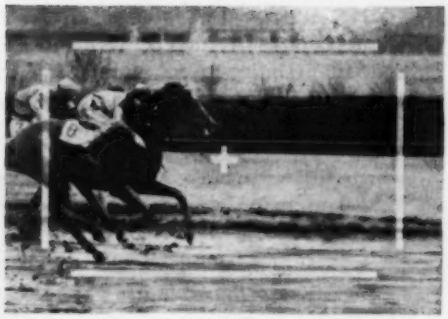
California's $9,000,000 atom smasher, a monster with a ring magnet 110 feet in diameter, will wield a power of 6,000,000,000 electron volts. Brookhaven's $3,000,000 machine, of 60-foot diameter, will attain 3,000,000,000 electron volts. And even the ultimate power that the dreamers had let their imagination picture—10,000,000,000 electron volts from a $15,000,000, 160-foot-diameter machine—may yet be realized. Design ideas for this colossus will be tested with the projected installations.

What an atom smasher in the billion-volt power range will look like is shown by the photo above, in which Dr. Livingston is examining a model of Brookhaven's design. Its enormous ring magnet, the doughnut-shaped object, encloses a vacuum tube that serves as the barrel of the mighty "gun."

Due to begin this summer or fall, construction of the superpowerful machines is more than a personal triumph for their planners. It means that America will lead the world in physical research at the most important time in history to do so.

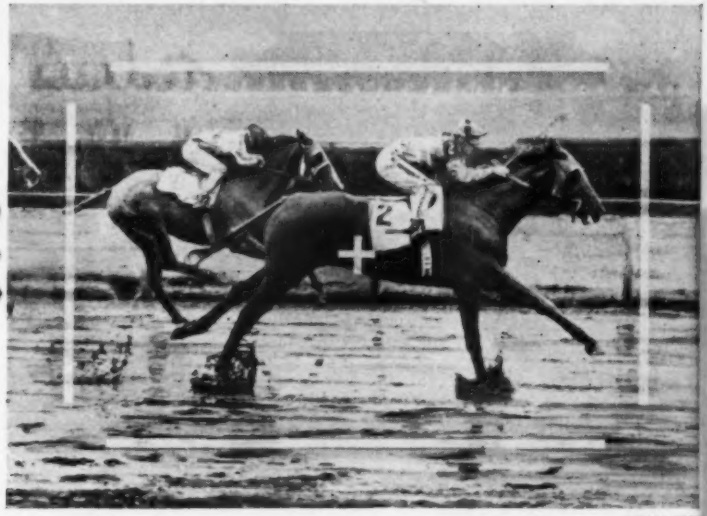
Alden P. Armagnac

No! Not yet! ↓



↑ No! Not now!

NOW! →



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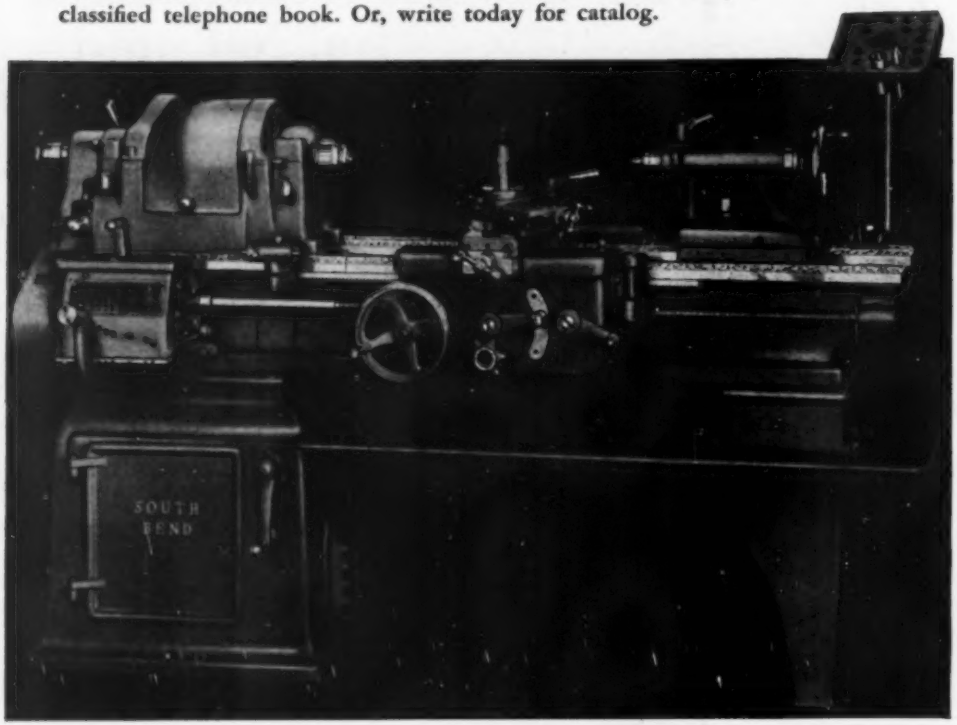

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QUICK CHANGE GEAR MODEL	$1640.50	$1382.50	$1153.50	$863.60	$312.70
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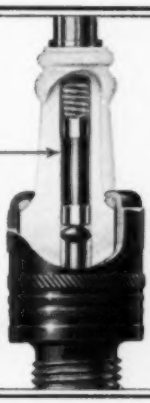
NEW BUILT-IN "RESISTOR" AIDS PERFORMANCE



New Auto-Lite Spark Plug Has Built-in "Resistor" That Helps Deliver Smoother Idling, Better Radio Reception—Gives Improved Economy and Longer Electrode Life

Gives smoother engine idling

—because of the wider initial spark gap setting possible on the "Resistor" plugs. This assists in burning leaner mixtures, and reduces misfiring at idling and throughout the speed range.

Improves radio reception

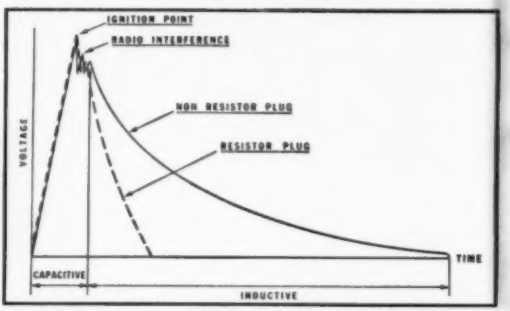
— by suppressing spark plug interference with radio, radio - telephone, radar and television reception. (Under 35 mv/m from 540 kc. to 150 mc. at 50 ft.)

Reduces electrode gap growth

—by increasing electrode life up to 200% and more . . . due to the virtual elimination of the inductive component in the spark discharge.

o o o

AUTO-LITE Ignition Engineers, working with leading automotive manufacturers, have developed the new Auto-Lite "Resistor" Spark Plug with this built-in resistor for improved operation and economy. Regular type Auto-Lite Spark Plugs (patented U.S.A.) will continue to be manufactured.



All spark plugs, including the new Auto-Lite Resistor Plug, ignite the fuel on the first peak of the capacitive component. However, the Resistor Plug dampens the remaining peaks so that radio, radar, and television interference is held to an acceptable level. Also, the Resistor virtually eliminates the inductive component that serves only to burn away the electrodes on ordinary plugs. The gap life is thus increased, making possible wider initial gap settings.

THE ELECTRIC AUTO-LITE COMPANY

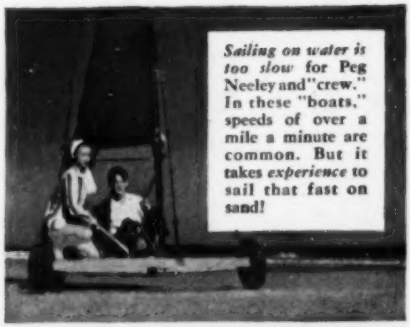
Toronto, Ontario — Toledo 1, Ohio

IT TAKES EXPERIENCE TO GO

Sailing on the Sand

On Florida's Daytona Beach, Skipper Peg Neeley "heels over" in a stiff breeze.

Skipper **PEG NEELEY** agrees: "In sand sailing—and in cigarettes too—**EXPERIENCE IS THE BEST TEACHER!**"



Sailing on water is too slow for Peg Neeley and "crew." In these "boats," speeds of over a mile a minute are common. But it takes *experience* to sail that fast on sand!

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More people are smoking CAMELS than ever before!

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Three leading independent research organizations asked 113,597 doctors what cigarette they smoked. The brand named most was CAMEL!